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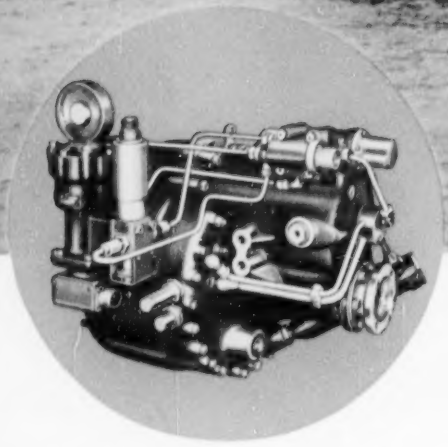

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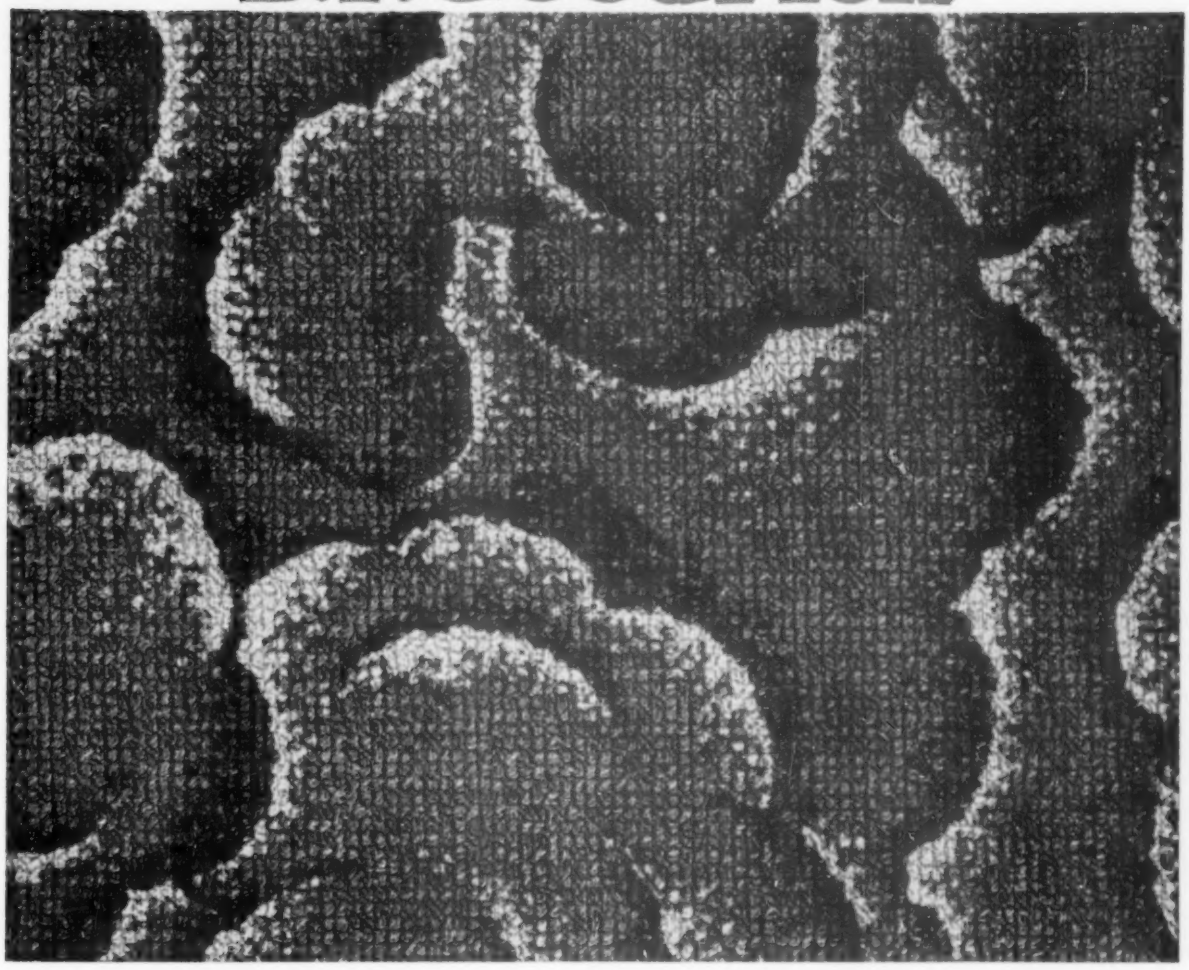

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KEEPING a commercial airplane's carpet clean used to run into money. The wool carpeting used by airlines trapped dirt, soaked up stains, and got grimy fast. Whenever it needed dry cleaning, which was often, it had to be removed from the plane. Extra carpets had to be kept on hand for quick replacement. And any solution to the problem which sacrificed beauty of the cabin was unacceptable.

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Aviation Week

Volume 58 — March 23, 1953 — Number 12

46,170 copies of this issue printed

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AVIATION WEEK • March 23, 1953 • Vol. 58—No. 12
Member ABP and ABC

Published weekly by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. **Publication Office: 99-129 North Broadway, Albany 1, N. Y.**
Executive, Editorial and Advertising Offices: McGraw-Hill Building, 330 W. 42nd St., New York 36, N. Y. Curtis W. McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A. Gerardi, Vice-President and Treasurer; John J. Cooke, Secretary; Paul Montgomery, Senior Vice-President, Publications Division; Ralph B. Smith, Vice-President and Editorial Director; Nelson Bond, Vice-President and Director of Advertising; J. E. Blackburn, Jr., Vice-President and Director of Circulation.
Subscriptions: Address correspondence to AVIATION WEEK—Subscription Service, 99-129 North Broadway, Albany 1, N. Y., or 330 W. 42nd St., New York 36, N. Y. Allow ten days for change of address.
Subscriptions are solicited only from persons having a commercial or professional interest in aviation. Position and company connection must be indicated on subscription orders.
Single copies 50¢. Subscription rates—United States and possessions, $6 a year; $9 for two years; $12 for three years. Canada, $8 a year; $12 for two years, $16 for three years, payable in Canadian currency at par; other Western Hemisphere, $10 a year; $16 for two years; $20 for three years. All other countries $20 a year; $30 for two years; $40 for three years. Entered as second-class matter, July 16, 1947, at the Post Office at Albany, N. Y., under Act of Mar. 3, 1879. Printed in U. S. A. Copyright 1953 by McGraw-Hill Publishing Co., Inc.—All Rights Reserved. Cable Address: "McGraw-Hill New York." Publications combined with AVIATION WEEK are AVIATION, AVIATION NEWS, AIR TRANSPORT, AERONAUTICAL ENGINEERING and AIRCRAFT JOURNAL. All rights to these names are reserved by McGraw-Hill Publishing Co.

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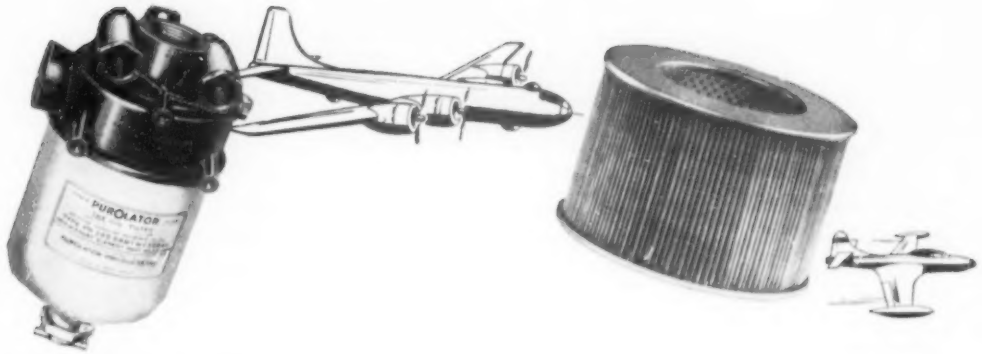

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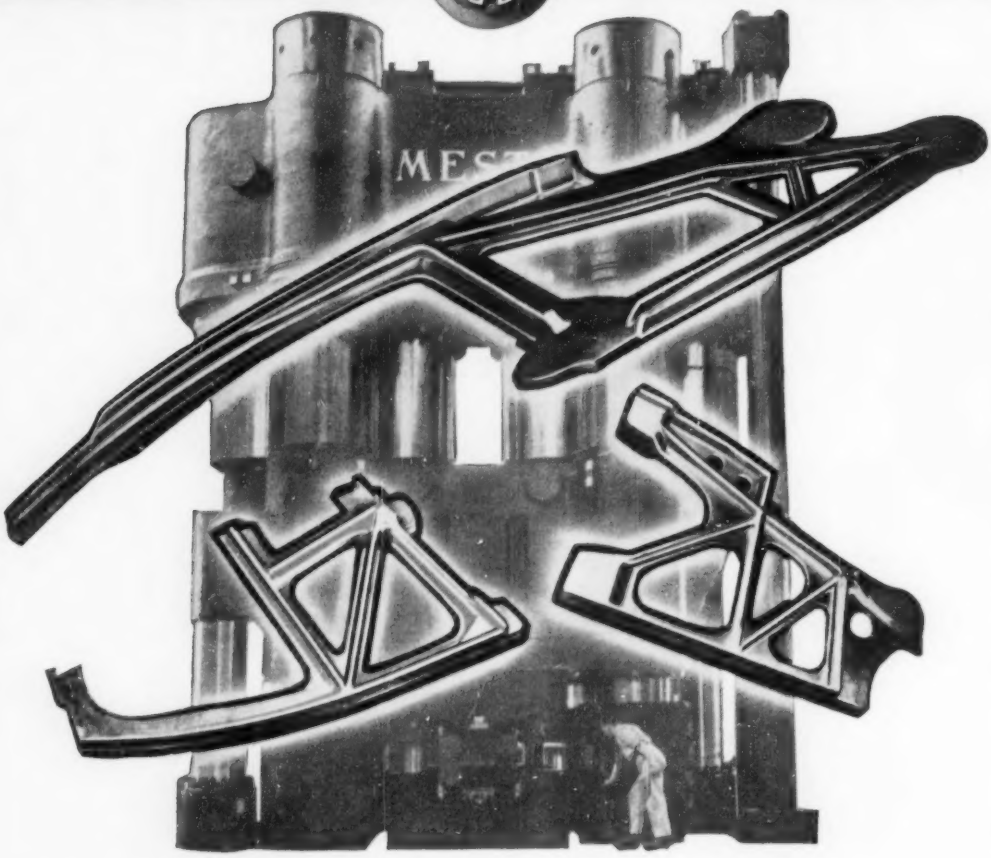

Greater Size and Speed in Aircraft have created engineering problems, the solution of which has required larger and larger forgings of high-strength aluminum alloy. *Examples* shown above are forged structural members used in a modern military bomber, the largest more than seven feet over all. These are forged on an 18,000-ton press, the biggest ever built in this country.

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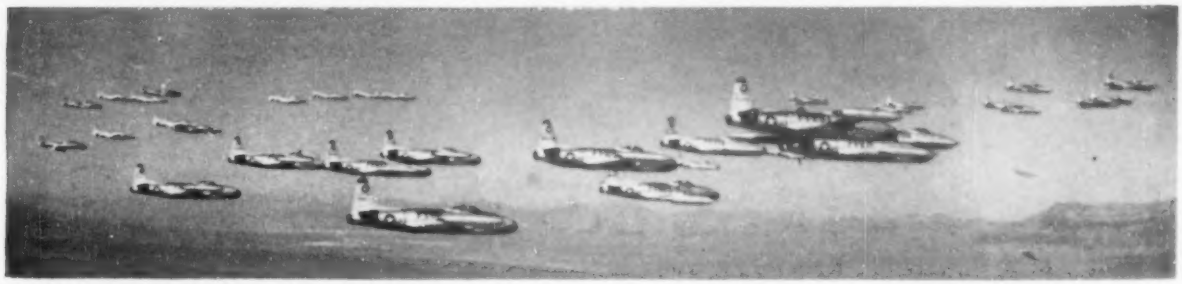

LARGEST MASS FLIGHT of jet-propelled fighters held in the continental U. S. was made Mar. 7 during USAF graduation ceremonies at Nellis AFB Air Training Command School, Las Vegas, Nev. Shown above are some of the 80 Lockheed F-80s that made the flypast; 80 North American F-86s also participated. Fifty of the pilots were USAF students, 12 were RAF students and the remainder were instructors. The planes took off at ten-second intervals, made 90-min. flight and landed at five-second intervals.

Domestic

Civil Aeronautics Board has started enforcement proceedings against owners of the nine companies affiliated with North American Aircoach System, alleging they dodge CAB's flight-frequency restrictions on business volume of individual nonskeds by "pooling" of four separate carriers. Full description of North American, largest nonscheduled airline sales operation, appeared in AVIATION WEEK (Aug. 18, 1952, p. 61).

Eastern Air Lines was ordered in a federal court test case last week to pay $65,000 damages to the children of two persons killed in the 1949 collision of an EAL DC-4 and a Bolivian P-38 over Washington National Airport, making the carrier liable for claims of $10-$15 million for deaths of 53 other persons in the crash.

Piper Aircraft is planning to drill for oil on farmland surrounding its Lock Haven, Pa., plant, according to a corporation amendment adopted recently by Piper stockholders.

UAW-CIO workers struck last week at General Electric's Evandale, Ohio, jet engine plant, (AVIATION WEEK Mar. 9, p. 15) where a walkout of AFL machinists two days earlier had tied up a large share of Air Force powerplant production.

Merger talks between Slick Airways and Flying Tiger Line have been revived by the threat of growing competition from combination passenger-freight carriers.

Helicopters operated by New York Airways are transferring mail between airliners at the metropolitan area's Idlewild International, La Guardia and Newark Airports, eliminating processing delays in the airfields' post offices.

Mrs. Minta Martin, 89-year-old mother of aircraft manufacturer Glenn L. Martin, died Mar. 14 in Baltimore. She was one of the first women to fly, making a flight 41 years ago in a plane built and piloted by her son.

A $4.9-million Air Force contract has been awarded to ACF-Brill Motors Co., Philadelphia, for production of B-47 camera pods.

Seventeen DC-3s, last of Eastern Air Lines' fleet of the two-engine transports, have been purchased by Leeward Aeronautical Service, Fort Wayne, Ind., for leasing to corporations and carriers.

Port of New York Authority recently accepted $150,000 in increased federal aid for construction of a passenger terminal building and related facilities at Newark (N. J.) Airport, boosting total federal obligation for the structure to $1,650,000.

Capt. Alger H. Dresel, Navy lighter-than-air ship pioneer, died Mar. 10 at Newport, R. I.

Maj. Gen. Kenneth E. Webber has assumed command of the Eastern Air Procurement District, New York, replacing retired Maj. Gen. Arthur Thomas.

National Association of Manufacturers Representatives recently re-elected Louis J. Sculley as president. Also named: Dan B. Brubaker, vice president; Ruth Gerhardt, secretary, and Robert Siff, treasurer.

Financial

Seaboard & Western Airlines reports a record net income and capital gain of $1,756,474 after taxes in 1952 and an all-time high operating revenue of $12,082,495.

Aeronca Manufacturing Corp. earned a profit of $852,152 last year from sales totaling more than $12 million. The Middletown, Ohio, company's backlog at the end of the year is reported at nearly $29 million.

Continental Air Lines has declared a dividend of 12½ cents per share on 400,000 shares of common stock outstanding.

Solar Aircraft Co., San Diego, increased its regular quarterly common stock dividend this month from 20 to 25 cents a share and also declared an extra common stock dividend of 15 cents per share.

International

Philippine Air Lines reported last week that net profits for 1952 totaled $433,521 from operating revenues of $15,607,375 and non-operating income of $316,884.

Swissair's revenue last year added up to $15,481,651, a 16% increase over 1951's total of $13,371,559.

New air transport company is being formed by Portugal's government to replace TAP Portuguese Airlines.

Aviation gasoline supply for airlines operating in Venezuela will be increased by a $35,113,636 expansion of Creole Petroleum Corp.'s refinery at Amuay on the Paraguana Peninsula.

Mark Birkigt, founder and president of Hispano-Suiza Co., died Mar. 14 in Geneva.

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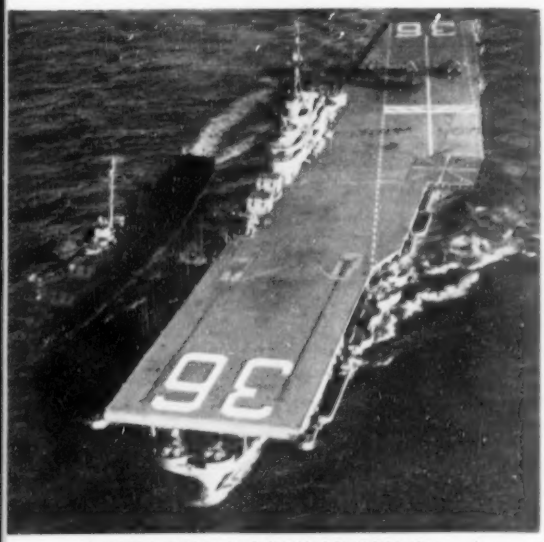
CHUTE CUTS VULCAN LANDING—Trailing its ribbon-type Irving braking chute, the four-jet Avro Vulcan deltawing bomber slows its landing roll on a snow-covered runway. Note that the plane's fence-type airbrakes are extended vertically above and below the wing surface. The plane obviously sits high above the ground on its long, multi-wheeled landing gear.

New Developments in Military Aviation

SUPER CONNIE LIFTS HEAVY LOAD—This Navy Lockheed R7V-1, military version of Super Constellation, recently took off at 145,000-lb. gross weight, 7½ tons more than its normal maximum load. Powerplants are four Wright R3350 Turbo Compound engines of 3,250 hp. each, turning Hamilton Standard Hydromatic props. Airlines are to get Turbo Compound Super Connies this summer.



NEW CARRIER DECK TESTED—First photos of USS Antietam's angled deck undergoing test. Dotted white line (photo above) outlines deck. At right an AD Skyraider takes off.

INDUSTRY OBSERVER

► Western military men expressed surprise at the evidence of good craftsmanship and maintenance practice on the captured MiG. And this craftsmanship was coupled with a very light construction—12,000 lb. overall weight. Chances are the MiG evidence will give support to those in the U. S. and Britain plugging the cause of light or stripped-down interceptors.

► SHAPE officers, Rolls-Royce and Gloster technicians have gone over the captured MiG-15 in Denmark thoroughly, with greatest interest apparently centering on the type of metal used in compressor blades of the jet's VK-1 engine—Russian version of the Rolls-Royce RD45 Nene, exported to the Soviet in 1946. It is assumed that Western investigators also will fly the MiG before returning it to Poland.

► Pentagon is buzzing with rumors of further procurement shifts aimed at cutting back future production of fast-obsolescing types and devoting funds to accelerating production of newer aircraft types. So far no firm cutback program has emerged from either USAF or Navy's BuAer.

► USAF reports that about 15 Wright J65 turbojets had to be removed from Republic F-84F Thunderstreaks and returned to the Wright plant at Wood-Ridge, N. J. for "minor repairs" to the compressor section. USAF expects to have the engines back at Republic this week for continued flight testing of early production model Thunderstreaks.

► Northrop has delivered its first modified F-89C Scorpions to USAF incorporating structural changes to eliminate wing failures previously encountered at high speeds and low altitudes (AVIATION WEEK Dec. 1, p. 16). USAF is feeding F-89Cs from its tactical units where they have been grounded since last fall to Northrop's Hawthorne plant where the modification work is being done.

► Missile production order USAF recently permitted Northrop to announce was for the Snark, a pilotless bomber type powered by a turbojet engine. Snarks have been flown in C-124 transports from Northrop's Hawthorne plant to Patrick AFB in Florida for flight testing.

► Gloster Javelin, deltawing all-weather fighter, recently got a favorable nod from USAF test pilot Lieut. Col. Dick Johnson, former holder of the world speed record, who flew the plane for evaluation in the off-shore procurement program. Third Javelin prototype is now flying but first production models are not expected for another year. Latest off-shore procurement plan for the Javelin is to finance manufacture by Fiat in Italy.

► Sikorsky plans another power increase for its HRS helicopter series, with a Wright R1820 rated at 1,025 hp. scheduled for the HRS-4. The power increase over the 700 hp. of the Wright R1300 now used in the HRS-3 will permit the copter to carry 10 combat-loaded troops plus crew.

► Navy is planning to switch production of its government-financed facilities being built by Chrysler and the Ford Lincoln-Mercury Division in the Detroit area to production of the Pratt & Whitney Aircraft J57 turbojet. Chrysler originally was scheduled to build the P&WA J48 and Ford the Westinghouse J40. Now Navy needs additional J57 production capacity for its program of alternate engines for the J40 (AVIATION WEEK Mar. 16, p. 18) because USAF has priority on J57 production programs at P&WA's East Hartford plant and the Ford Aircraft Engine Division at Chicago.

► Allison Division of General Motors Corp. is building large new facilities for development and testing of turbojets on a hundred-acre site near Indianapolis. New facilities eventually will house all Allison jet development facilities and will include eight new test cells, 132,000 ft. of experimental shop, an engine components test laboratory. The new test cells will be protected by half-inch steel plate, with all fuel lines located externally.

WHO'S WHERE

In the Front Office

Joseph V. Miccio, general manager of Curtiss-Wright's Electronics and Columbia Plastics Divisions, has been elected a vice president of C-W.

H. Scott Hanville, Jr., and **Anthony G. Brown, Jr.,** are new vice presidents of Royal Electric, Inc., Jamestown, Ohio. Brown is succeeded in his former position as sales manager, aviation products, by **Paul J. Papanek.**

Harry E. Beane has been appointed vice president-sales of Bristol Co., Waterbury, Conn.

Changes

James P. Hobstetter, former president of Southern Ohio Aviation Co., is general manager of Cordair Engineering Co., a new firm that plans to design aircraft seats and other aviation products. **R. G. Naugle,** formerly chief project engineer for the Air Force on the B-36, is chief engineer.

Francis T. Fox, former manager of Worcester (Mass.) Municipal Airport, has been named acting director of aviation for Philadelphia.

C. A. Sereno has been appointed chief engineer of Air Associates, Inc., and **C. B. Terry** has been promoted to general manager of the Teterboro, N. J., company's Electronic Equipment Division.

John R. Schwarzkopf has joined Bonanza Air Lines as director of public relations.

Leonard C. Olson is Northwest Airlines' new director of regulations and procedures, operations department.

Gene B. Spaulding has been named superintendent of electronics at Temco Aircraft Corp., Dallas. Other recent Temco promotions: **Leon W. Mason,** assistant superintendent of electronics; **Jack L. Crowson,** superintendent of flight ramp and modification, and **Doyle Beasley,** assistant superintendent of night operations.

Gerald R. Thornton has been appointed assistant to the general sales manager of Trans World Airlines. Also named to new posts by TWA: **Richard Mazzarrini,** European sales director, Paris; **Richard P. Spater,** district sales manager, for Italy, and **H. G. A. Meili,** Switzerland district sales manager. **Daniel P. Reid** has been granted a leave of absence from TWA to accept a post as general sales manager of Ethiopean Air Lines.

G. K. Johnson has been appointed assistant to the general manager of Chance Vought Aircraft, Dallas, and **W. L. Hoffman** has been promoted to materials manager.

David M. Mason has been named assistant materiel manager of Piasecki Helicopter Corp., Morton, Pa.

Honors and Elections

Irving Kalikow, Alfred H. Tinney, Gordon B. Wilkes, Jr., and **Irving K. Clark** have received General Electric's Charles A. Coffin Award for "outstanding achievement" in the aviation industry.

HAMILTON STANDARD . . . leader for years in propeller design and production, is supplying other equipment for such outstanding new aircraft as the United States Navy's McDonnell F3H jet fighter.

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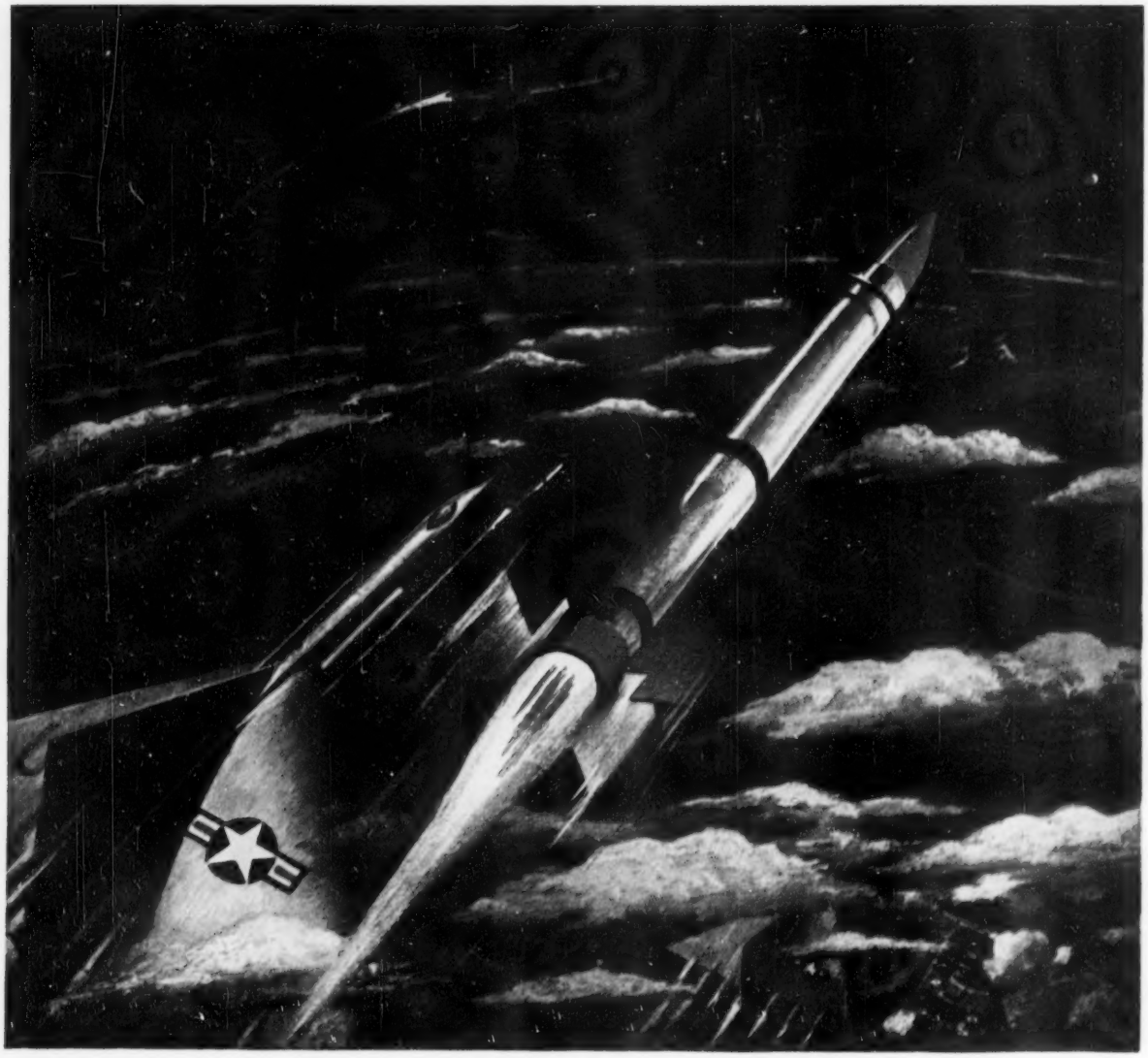


Missile with a "one track mind"

. . . Bomber Defense

Defensive guided missiles launched from supersonic aircraft will depend upon electronic marvels that come as close to simulating human intelligence as any mechanism ever devised. Important functions of these "weapons of the future" are typical of those entrusted to systems made by Arma Corporation.

Complex electronic and electro-mechanical controls from Arma are an integral part of many of America's most advanced weapons. In basic research, design, development and manufacture, Arma Corporation has worked in close cooperation with the Armed Forces since 1918—and more recently, the Atomic Energy Commission. *Arma Corporation, Brooklyn, N. Y.; Mineola, N. Y. Subsidiary of American Bosch Corporation.*

ARMA ADVANCED ELECTRONICS FOR CONTROL

Washington Roundup

USAF Procurement Probe

Main industry interest is focusing on the comprehensive investigation of Air Force's procurement program planned by a Senate Armed Services Investigating Subcommittee headed by Sen. Styles Bridges.

Sen. Styles Bridges

First on the agenda:

Kaiser-Frazer Corp. C-119 contract. Investigators are now doing groundwork research. According to Chairman Bridges, the subcommittee expects to open public hearings in a few weeks. It is anticipated that these will:

• Pit two major aircraft firms—K-F and Fairchild Engine and Airplane Corp.—against each other. Fairchild officials have challenged the wisdom of diverting production of the C-119, developed by Fairchild, to K-F. Fairchild's unit cost is now $265,000 toward the end of a long production run. K-F's cost of $1,200,000 for the first plane is expected to taper down to $500,000 for the final plane.

The subcommittee expects to look into the feasibility of switching the uncompleted balance of the K-F contract to Fairchild.

Fairchild reports it could be producing planes on the K-F contract in a month, and with increased volume its present $265,000 unit cost probably would go down.

• Ascertain whether the USAF's military staff, headed by Gen. Hoyt Vandenberg, concurred with the civilian secretariat, then headed by former Secretary Thomas Finletter and former Undersecretary John McCone, in letting the C-119 contract to K-F. There were widespread reports at the time that the Kaiser-Frazer contract touched off a sharp conflict between Vandenberg and Finletter.

Other projects on the subcommittee's agenda:

Policy of establishing second sources of supply. This policy, followed by Army and Navy as well as USAF, raises the issue, as in the K-F case, of whether the higher unit costs incurred to cover tooling-up costs is justified. Subcommittee is weighing objections by manufacturers.

Performance in meeting production targets. Taking up where the Johnson Preparedness Subcommittee left off last year, the group plans to go into all aspects of aircraft production performance.

Scotch Bilateral Air Pacts?

Air transport industry so far shows only mild concern to the future threat facing international operations:

Some 40-plus bilateral air agreements opening international gateways to U.S. carriers would be invalidated, temporarily at least, by an amendment to the constitution proposed by Sen. John Bricker and co-sponsored by 62 other senators.

If the constitutional amendment is adopted—which will require a two-thirds vote by the Senate and the House and ratification by three-fourths of the states—this is what would happen:

• **All existing bilateral** executive air agreements automatically would be invalidated. They would be reinstated as effective when and if Congress passed legislation so providing.

• **All bilaterals negotiated** after adoption of the constitutional amendment would require congressional implementation to remove the 1938 Civil Aeronautics Act's requirement for full CAB hearings in the granting of certificates to foreign lines.

Chief airline concern so far seems to be that during the period of invalidation foreign governments would cancel agreements, then press for more favorable terms for their carriers in renegotiations.

Local Service Lines' Dilemma

Local service lines, which can't get off subsidy until they acquire an economical plane for their operations, are faced with this situation:

• Major aircraft firms, with heavy military orders, have turned thumbs down on development of a local service plane as financially too risky, particularly in view of the temporary status of local line certificates.

• Now, the proposal to take some of the risk out of the project by authorizing $8 million government-financing, introduced by Rep. Carl Hinshaw, is faced with opposition from the aircraft industry. Manufacturers, antagonistic to the "strings" and "interference" attached, are opposed to government-financing of commercial types. They feel that an exception would set a precedent.

Meanwhile, local lines' hopes rest on these possibilities:

• **Development of the F-27** by Royal Dutch Aircraft Factories (Fokker). But availability is three years off. Shipment of fuselages to Fairchild, U.S. licensee, for assembly with parts and accessories would cut down the heavy tariff on aircraft imports.

• **Development of the CL-21** by Canadair, Ltd. Local lines are now anxiously awaiting the decision of Canadair's board on whether to go into production.

• **Development of a transport version** of the Chase-123 by Kaiser-Frazer Corp. K-F is now considering the project. Government-financing might be a necessary condition.

CAA Budget Future

Congressional action on Civil Aeronautics Administration's fiscal 1954 budget promises to be cut and dried, with reductions down the line.

• House Appropriations Subcommittee on Commerce, headed by Rep. Cliff Clevenger, is making fast time on hearings. They will set a record for brevity.

• Committeemen are reasonably satisfied with both CAA and CAB administration, and the tiffing that has cluttered previous hearings isn't expected.

• CAA isn't expected to arouse local opposition to congressional cuts, as in past years. CAA's practice has been to warn localities that under cuts contemplated by Congress the agency would have to abandon this or that local facility. But Secretary Sinclair Weeks is cooperating closely with Congress this year and the prospect is that overall cuts in funds for airports, control towers and other CAA projects will slide through Congress without the usual flurry of local pressures against them.

—Katherine Johnsen

AVIATION WEEK VOL. 58, NO. 12 MARCH 23, 1953

NACA Research Goal: Mach 5 Tunnels

- **U. S. must double current supersonic range to hold lead in aircraft development race, director says.**
- **Broader test scope is urged to solve "heat barrier" and to try out advanced, full-scale rocket engines.**

By Robert Hotz

The speed range of supersonic research must be doubled, its intensity increased and its scope extended to include new problems such as the "heat barrier" if American air power is to maintain its technical superiority in the supersonic era, Dr. Hugh L. Dryden, director of the National Advisory Committee for Aeronautics, has told AVIATION WEEK.

Among the vital research facility requirements for the immediate future, Dr. Dryden listed:

• **Increasing speed range** of windtunnels from their present capacity of twice the speed of sound to Mach 5. Goal of immediate postwar sonic research was exploration up to Mach 2. But pace of aircraft development has been so fast that the military already has requirements for research data up to Mach 5. Combat aircraft already are being designed for twice the speed of sound.

• **Modifying existing supersonic windtunnels** with extremely-high-temperature heaters to permit study of the effects of aerodynamic heating (the heat barrier) on aircraft structures. During test flights to approximately Mach 1.5, the Douglas Skyrocket experienced skin temperature rises up to 270F. Early research on this problem indicated startling effects on certain types of aircraft structures under extreme temperatures encountered in supersonic flight.

Current windtunnel techniques produce a cooling effect in the test sections that often bring the air close to liquefaction. These conditions must be countered for research on aerodynamic heating at supersonic speeds.

• **Construction of rocket test facilities** capable of handling full-scale rocket engines of advanced design, and larger size utilizing new type fuels. These new fuels such as anhydrous hydrazine and fluorine go beyond the performance possible with gasoline and oxygen base fuels. These fuels, when suitable rocket engines are designed to use them, offer an opportunity to achieve significant ranges with rocket-powered aircraft and missiles.

▶ **Postwar Analysis**—Here is how Dr. Dryden analyzes the seven postwar years of supersonic research:

• We have passed through the period of initial penetrations beyond Mach 1.0 by a variety of specialized research aircraft to the point where the most modern combat aircraft can operate slightly above Mach 1.0 for short periods during diving. The transonic dive appeared within the past 18 months as a new feature of air combat in MiG Alley battles between USAF F-86 Sabres and Russian-built MiG-15s. Both these aircraft utilized 1945 research data.

• We are now approaching a period of combat operations at low supersonic speeds during level flight. However, the margin of thrust over drag will be so narrow that high supersonic speed will be difficult.

• Before we enter an era when combat aircraft can operate regularly at speeds up to Mach 2 with sufficient stability and control to be efficient firing and bombing platforms, many new problems of supersonic flight must be solved first of all.

▶ **Unsolved Problems**—Among these basic unsolved problems of supersonic flight listed by Dr. Dryden are:

• Development of more efficient and more powerful engines; improved air inlet design, and matching of inlet design to engines.

• More drag reduction through improved aerodynamic design with a definite trend toward extremely thin airfoils.

• Improved handling characteristics of aircraft through the transonic range with development of extremely complex artificial stability devices a growing necessity.

Noting that "recent failures of high-speed aircraft in flight indicate that we do not fully understand all of the problems of highspeed flight," NACA now maintains a fleet of the latest and fastest combat aircraft, including the Vought F7U Cutlass, North American F-86 and F-93, Grumman F9F-6 Cougar and Boeing B-47 Stratojet. These are in addition to its specialized stable of supersonic research aircraft, ranging from the X-1 to X-5 and including the Douglas Skyrocket.

Dr. Hugh L. Dryden

Dr. Dryden noted that the sharp rise in both speed and altitude of modern aircraft has resulted in "significant deterioration of their dynamic stability." Forces acting on the subsonic flight of propeller-driven aircraft and their resultant oscillations are mild compared to the effect with both force and rate of oscillation multiplied by supersonic speeds until they reach the point where pilots no longer can cope with them.

▶ **Stability Problems**—Among the principal stability problems still plaguing highspeed aircraft and requiring intensive research, the following are cited by Dr. Dryden:

• **Pitchup.** This is a tendency for an aircraft to lift its nose violently, usually in a tight turn. The pitchup suddenly tightens the turn and quickly imposes a heavier G-load than was anticipated, sometimes results in structural failure. Early MiG-15 model has a marked pitchup tendency, and one USAF fighter experienced it when speed brakes were extended. There have been some successful specific fixes such as wing fences and special tail locations but little basic knowledge has been accumulated.

• **Flutter.** "Flutter today is at best an art not a science," NACA commented. Extreme scale of flutter encountered under varying ranges of speed complicated by other factors such as vibrating tiptanks and engine nacelle pods make the scope of the problem so extensive that it almost defies analysis by present

methods. Wing flutter is encountered in swept wings through the transonic range and tail flutter has produced the crash of more than one experimental delta-wing prototype.

• **Dutch roll.** This combination of yaw and roll has been present in aircraft since man first flew, but its force has become so strong and its frequency so rapid at supersonic speeds that it gets beyond control of human reactions. Frequency has increased from more than a second in World War I aircraft to more than several times per second in current subsonic jet fighters.

• **Buffeting.** This occurs with varying intensity in all highspeed aircraft.

• **Extreme lateral oscillations.** During the highest speed flights of the Douglas Skyrocket, test pilot William Bridgeman reported violent rolls with the wings dipping as much as 75 deg. on a side at a rate of 86 deg. per second. The ride became so rough that power was cut, but oscillations increased in violence and only unorthodox and extraordinary control movements affected recovery.

Extensive NACA research into the early phases of oscillation problems indicated they cannot be completely solved by aerodynamic means alone and a variety of artificial stability devices, either mechanical or electronic, have been developed to aid the human pilot in controlling the plane during these maneuvers.

But NACA predicts that even these artificial stability-type devices will not enable sufficiently precise flight by supersonic fighters. Because of human limitations imposed by the growing list of duties required of the pilot at supersonic speeds with corresponding less time to do them, it will be necessary to develop "super autopilots" that will completely control supersonic fighters during critical maneuvers.

F-86Fs to Europe

U. S. Air Forces in Europe will be strengthened with the latest F-86F Sabres, straight from the North American Aviation, Inc., production line at Inglewood, Calif. These are the latest production models of the Sabre series. The European shipment will mark the first time they have been sent abroad.

Bulk of Sabres now in service with USAF, RAF and RCAF in Europe are F-86Es. The "augmented squadron" of F-86Fs (about 30 aircraft) will leave for Europe soon via the North Atlantic ferry route. USAF does not plan to use aerial refueling for the flight.

Fred B. Lee

Civil Air Selections Await Senate Action

Senate confirmation was awaited last week for appointments of Harmar D. Denny, Jr., and Chan Gurney for Civil Aeronautics Board membership and Frederick Billings Lee for Civil Aeronautics Administrator. Oswald Ryan, a Republican, still retains the CAB chairmanship conferred on him by President Truman.

• **Denny** is a 67-year-old former Republican congressman from Pittsburgh, lawyer-investor and Air Force officer. He will hold the balance of power on some airline competition policy decisions of the five-man CAB. He fills a term expiring this year, but a full six-year appointment next January appears likely.

• **Gurney** has been a Board member more than a year. His six-year reappointment by the Senate is certain. He was South Dakota senator for 12 years and headed the Senate Armed Services Committee in the 80th Congress. He follows no set line on CAB decisions. He leans more toward Ryan's side on economic policy, opposing "wasteful" competition, but his closest friend on the Board is Democrat Joseph Adams.

• **Lee** has been deputy CAA administrator since 1947 and was CAA Program Planning Officer in 1946. As a Navy pilot he pioneered in Naval instrument flight and night-attack development, technique, and training during World War II. He flies his own Navion. Lee has the backing of both Air Line Pilots Assn. and Air Transport Assn., and he appears certain of confirmation by the Senate as CAA administrator.

Denny is the only newcomer to federal civil aviation regulation. But he was an Army bomber pilot in World War I, and in Air Force as a lieutenant colonel in World War II, serving as assistant air inspector, Eastern Flying Training Command, and graduating from the Command and General Staff School, Ft. Leavenworth, and the Advanced Air Inspector's School at Orlando, Fla.

Defense Report

- **Study urges $16-billion air barrier buildup.**
- **But plan does not call for counter-attack force.**

First signs of a Washington movement to speed up and expand defense mobilization, particularly defensive strength against atomic air attack, have appeared to counter demands in Congress for cutbacks in military spending.

A study by Massachusetts Institute of Technology, under Air Force contract, calls for an air defense buildup program that would cost nearly $16 billion over a few-years' period. The study has been submitted to Defense Depatrment and is being evaluated by the newly appointed committee to advise on defense of Nort America. It stresses the continuing buildup of long-range Russian offensive air power and the vulnerability of key U. S. points to atomic attack.

► **Working Paper**—The program proper was not fully approved by the Air Force, or Army and Navy. Brig. Gen. Sory Smith, Director of USAF Information, told AVIATION WEEK:

"The Air Force buys a lot of it but certainly not all. Air defense is only a part of the problem. Fighters and bombers are needed for retaliatory action."

The report is serving as a "working paper." The prospects appeared to be that it will be at least a month, and more than likely several months before a program is agreed upon by the Administration for submission to Congress.

Chairman Dewey Short of House Armed Services Committee, after White House briefings, said international developments under the new Soviet leadership are the key to the situation:

"When a program is laid out, we will want the view of all the services. Whether we can spend $16 billion more for defense in the next two years is the question. But this is no time to relax, and regardless of what it costs the U. S. must have what is necessary for defense."

Chairman John Taber of House Appropriations Committee said defense leaders have given no indication to him

that there will be a requirement for any additional funds in the coming '54 fiscal year budget now being reviewed by his group.

▶ **Basic Questions**—Senate Minority Leader Lydon Johnson and Sen. Stuart Symington, former Secretary for Air, raised the issue of a bigger defense buildup in public speeches, helping to build a favorable public atmosphere for Administration approval of added military spending that would throw off its aims for a balanced federal budget.

The "basic questions" before us, Johnson declared, are these:

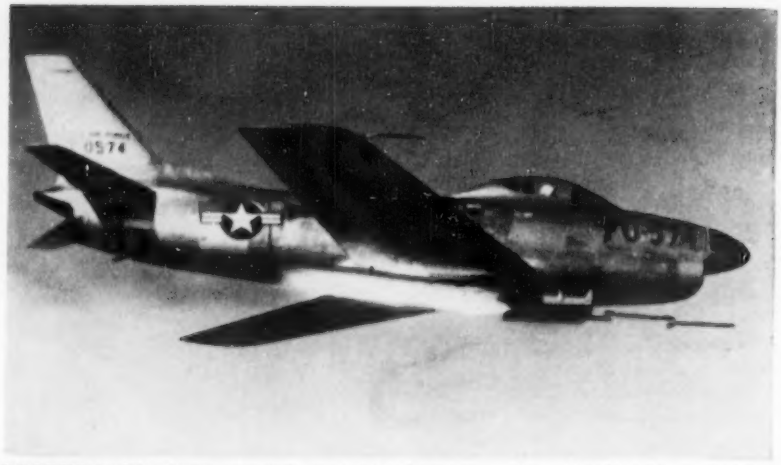
- "Does an aggressor nation have the planes and the weapons with which the United States can be attacked at any and every point?
- "Does an aggressor nation have a stockpile of atomic bombs that could be used to strike at every American city?
- "Do we have a defensive force adequate to beat off an attack?
- "Do we have a force that could deliver devastating counterblows against an enemy, or have we placed our faith in equipment that is obsolete?
- "How much time do we have before an aggressor nation will be up to its peak strength?
- "Is our military force large enough to keep pace with the buildup of the aggressor or should we be building more?

"There are answers to all those questions, and they are not pleasant answers," Johnson said. "But they must be faced."

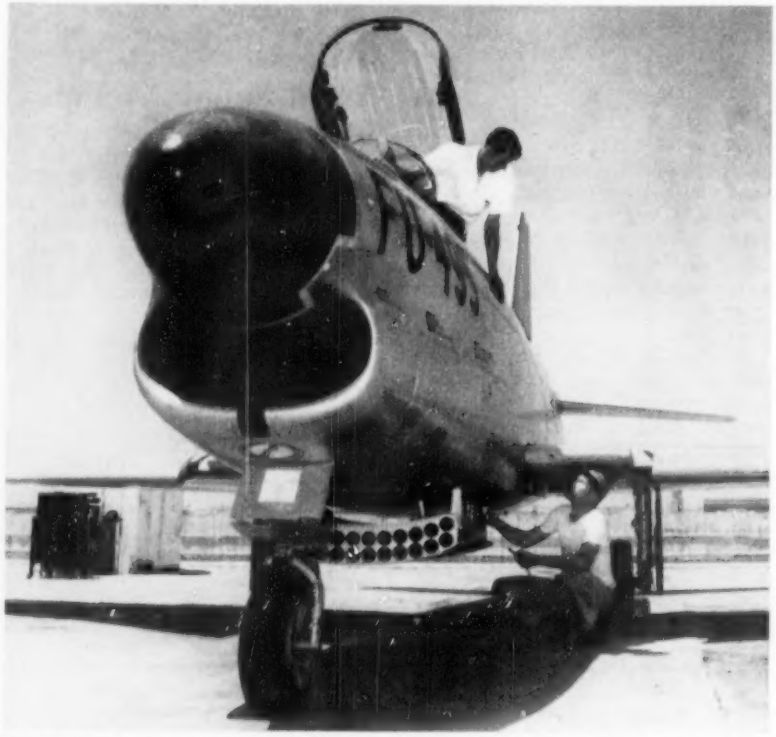
▶ **Facts and Figures**—He called on President Eisenhower to put the facts and figures before the country and urged that the President "be told that he will have the support of the Congress no matter how difficult the decisions that must be made."

"He has the responsibility for leadership," Johnson declared, "because he is our Commander in Chief. In calm, measured words, the people must have the facts—the facts upon which decisions can be based. I hope that when the time comes the President and the Congress can work together to arrive at the correct answers to the basic questions before us."

Membership on the Committee to Advise on Defense of North America, which is now coordinating Defense Department's evaluation of the MIT report, includes Arthur Raymond, vice president, Douglas Aircraft; N. J. Kelly, president, Bell Telephone Laboratories; Walker Cisler, president, Detroit Edison Co.; S. C. Hollister, Dean of Engineering, Cornell University; S. L. Hozde, president, Purdue University; C. C. Lauristen, physics professor, California Institute of Technology; H. S. Vance, chairman of the board, Studebaker Corp.; R. E. Wilson, chairman of the board, Standard Oil of Indiana.



ROCKET LAUNCHER extended, an F-86D Sabre fires a salvo of Mighty Mouse missiles.



CLOSEUP of retractable launcher showing compartments for two-dozen 2.75-in. rockets.

F-86D's Rocket Launcher Shown

Air Force has taken the wraps off the hitherto secret retractable belly-mounted rocket launcher fitted to the North American F-86D Sabre all-weather fighter.

The novel rocket mount holds 24 2.75-in. Mighty Mouse missiles, each said to have the destructive force of a 75-mm. artillery shell.

The plane closes on its target using extensive avionics equipment. On target, the rocket launcher is extended, the missiles are fired and the launcher immediately pops back into the fuselage. Thus a minimum amount of drag is presented for only a brief time.

The photos above depict the launcher in actual use and a closeup of the unit in the extended position.

The all-rocket-armed F-86D is powered by a General Electric J47GE-17 engine with afterburner. Last November one of these planes, fully armed, established a world's speed record of 698.5 mph. over a three-kilometer course.

AEDC Project

- **USAF tosses Tullahoma problem to Congress.**
- **Sen. Gore suggests four methods of operation.**

Air Force last week tossed back to Congress the question of who should operate the Arnold Engineering Development Center at Tullahoma, Tenn.

Here are the latest developments:

• Secretary for Air Harold Talbott urged repeal of the provision tacked onto USAF's current 1953 fiscal year budget under which payments to Aro, a subsidiary of the St. Louis firm of Sverdrup and Parcel, Inc., are barred after Mar. 31. He asked the repeal in letters to chairman John Taber of House Appropriations Committee and chairman Styles Bridges of Senate Appropriations Committee. Talbott's request was cleared by the Secretary of Defense and the Director of the Budget Bureau.

• Repeal faced opposition in both House and Senate committees. Sen. Albert Gore, who led the fight against Aro operation last year as a member of the House, said he planned to request thorough exploration of the possibilities for four types of AEDC operation he considered preferable to operation by Aro. These were, in order of preference: (1) Direct operation by USAF; (2) Direct operation by National Advisory Committee for Aeronautics, or the Navy; (3) Operation by a non-profit organization; (4) Operation by another for-profit firm.

• Aircraft Industries Assn. announced opposition to a direct government operation of the facility. "Although action taken by Congress contemplates the cut-off of funds to Aro after March 1953," the association stated, "the industry . . . continues to recommend that AEDC be operated by a private contract organization. Industry is firmly opposed to government operation of these facilities, either on a military or civil service basis."

Faced with the likelihood of delay in congressional repeal to the Aro proviso, Talbott said he hoped "that an interim contract with Sverdrup and Parcel, Inc., for the operation of the center on a no-fee basis can be entered into to meet the problem for several months commencing Apr. 1. I must state with emphasis, however, that I have no assurance whatever that the Bureau of the Budget and the General Accounting Office would approve such an arrangement."

▶ **Talbott Position**—In explaining his position, Talbott stated that although "there has been some disagreement as to whether or not the compensation paid to Aro . . . was excessive. . . . I believe it is generally agreed, however, that Aro has done its job efficiently and that the development of the center has proceeded as fast as could be expected. It would be most uneconomical and unwise, in my opinion, to risk losing the technical skills and experience that have been accumulated by the organization and its employes if they can be retained on the basis of a compensation which is fair and reasonable.

"I feel that it is appropriate to continue the contractual relations between Aro and the Air Force under a cost-plus-fee arrangement. The amount of the fee must be fair and reasonable and will be subject to annual negotiation. It will not necessarily continue to be the same in subsequent years. The Air Force will continue to study the method of operation of the center, and, if in the future a more economical or effective method is found to be practical, the Air Force will not hesitate to make a change."

Meanwhile, both NACA and Navy, in replies to queries by Gore, reported they are qualified to take over operation of AEDC if directed to do so, but recommended against this course.

▶ **Navy Reply**—In his reply, Assistant Secretary of Navy for Air John Floberg stated, "The Navy has had considerable success in the operation of large research facilities such as the Naval Research Laboratory, and it also operated limited windtunnel facilities, although a major portion of the Navy's aerodynamic research work is performed by the NACA. In answer to the specific question . . . I believe that the Navy could effectively and efficiently operate the AEDC if directed by appropriate authority to do so, but I would be reluctant to see it so directed."

Observing that "in fairness to the Air Force, it should be pointed out that recruitment and retention of properly qualified technical personnel are difficult tasks under present conditions," Floberg proposed that "if it were to be decided for some reason that the Air Force would no longer have the managerial responsibility for the AEDC, the fact that it has, from its inception, been planned as a national research facility, would seem to make it more appropriate to transfer the responsibility for this important project to the NACA where it would be available for use both by the armed forces and by industry."

▶ **NACA Letter**—J. W. Crowley, associate director for research, replied to Gore that "the NACA is now operating large windtunnels and propulsion test facilities and has on its staff technical experts capable of operating facilities like those under construction at the AEDC." He pointed out that the operation of an additional large facility would require reassignment of NACA personnel "with consequent interruption and delay to NACA's current high-priority program of aeronautics research, much of which is in direct support of the development programs of the military services."

Crowley also said that policy questions which should be discussed by the NACA executive committee are involved. As an example, he pointed out that "the major purposes of the AEDC are the evaluation and development testing of specific advanced models of military aircraft, missiles and engines, which are functions assigned to the military services. It is doubtful whether these functions should be assigned to NACA."

More Training Urged For Aviation Workers

Serious shortages of skilled workers in the aviation industry could be eliminated by setting up short-term training and apprenticeship programs in aircraft maintenance and production plants, the U. S. Bureau of Apprenticeship reports.

In a summary of 1952 activities, the bureau says new apprenticeship programs and expansion of existing on-the-job training produced "gratifying results" last year in several airlines and aircraft manufacturing companies.

Air Force bases continued expansion of apprentice training in maintenance shops, employing more than 1,270 trainees and producing 215 skilled journeymen by the end of the current fiscal year.

Companies setting up or expanding programs included Aircraft Engine Division, Ford Motor Co., Chicago; Lockheed Aircraft plant, Marietta, Ga.; Boeing Aircraft plant, Seattle, and North American Aviation Co., Los Angeles.

Pan American World Airways expanded its apprentice system through redesign of shops to allow supervisory training, the bureau says. Braniff Airways and Northwest Airlines both enlarged their regular on-the-job training facilities.

Jap Air Import Firm

(McGraw-Hill World News)

Tokyo—Japan Air Carrier Service Co. has been formed in Tokyo with $200,000 initial capital to handle imports of U. S. aircraft and parts. Parent firms are Marubeni of Osaka, Oriental Aircraft Industry Co. of Tokyo and Air Carrier Service, Washington, D. C.

U. S. Tests EKCO on Copters

British ground control approach radar is evaluated by ANDB, setting sights on all-weather helicopter flight.

Quantico, Va.—Early long-range developments pointing toward helicopter instrument flying are being started here by a joint action of the Marine Corps and the Air Navigation Development Board.

The modest evaluation program, which is now going on with the new low-cost British-built EKCO ground control approach radar, is an early move in the broad program of ANDB's Helicopter Navigation Guidance Group. While most of this program still is on paper, it seeks eventually to make it possible for helicopters to continue instrument flight under weather conditions that trouble fixed-wing craft.

▶ **Not Around Corner**—However, most experienced helicopter pilots will agree they do not care to fly on instruments in today's helicopters. The rotorcraft leave much to be desired in the degree of stability provided, except in a few cases under autopilot conditions. Because of the lack of stability, no civil clearances have yet been given in this country for unrestricted helicopter instrument flight operations. Los Angeles Airways has a restricted clearance permitting its copters to climb through haze under a scattered cloud condition.

Currently, development is going on with artificial horizons and other instrumentation specifically adapted to the helicopter. Also new aerodynamic devices aimed at better stabilization of the rotary-wing aircraft, have been demonstrated to be practical for single-rotor and tandem machines by the National Advisory Committee for Aeronautics and Navy.

But until it has been established that the helicopter is ready to be controlled by a pilot without exceptional skill or without inducing excessive fatigue under instrument conditions, ANDB does not expect to recommend instrument flight operations for helicopters.

ANDB spokesmen fully expect the present problems will be overcome by developments now underway and that eventually helicopters will be able to continue instrument flight operation under weather conditions that would be regarded as near zero-zero for fixed-wing aircraft.

Tentative planning calls for assignment of lower enroute altitudes to helicopters and separation of helicopter traffic from airplane instrument approach patterns. Current thinking calls for a 300-ft. ceiling and half-mile visibility minimums for helicopter visual flight regulations.

More than 400 radar-controlled practice approaches by Marine helicopters and fixed-wing planes already have been conducted here, using the EKCO ground control approach radar.

EKCO OPERATOR centers azimuth and elevation of approachable copter on beam of airport radar approach aid in ANDB tests.

The one-man equipment installed here for ANDB evaluation tests is fitted into cabinet console designed for air transportability. But basically it operates the same as the EKCO equipment used in England and described in AVIATION WEEK (Dec. 8, 1952 p. 59).

▶ **Broad Program**—Capt. G. C. Miller, Navy representative on ANDB, says the device is undergoing a six-months' test that started Feb. 1 for possible military and civil uses as a part of the broad program of ANDB's Helicopter Navigation Guidance Group. Plans for purchase of additional sets in this country will depend on evaluation results. Two U. S. Navy GCA operators are directing the EKCO-controlled approaches.

E. K. Cole, Ltd., the British manufacturer, already has received orders for 25 of the sets from the Royal Air Force as the result of similar British evaluations at Blackbush and Benson Airports.

ANDB purchased the U. S. evaluation set with spares for $15,000. Gerald O'Flynn, Cole's technical representative, says the manufacturer expects to sell the sets in quantity for less than £5,000 ($14,000) in Britain but that no price has been set for U. S. sales.

▶ **Low Density**—Designed for instrument approaches in low-density traffic locations, the one-man set will land from 10 to 12 aircraft an hour. It is not designed for continuous surveillance.

A manually operated VHF direction finder is locked in with the radar antenna (dish) so that the operator, when he takes a bearing on a transmission from the aircraft, is pointing his three-degree radar beam directly in azimuth toward the plane. It is necessary for the operator to locate aircraft on elevation by giving the pilot "steers" and instructing him to fly at a specific safety height until an indication appears on the radar scope. All that the pilot needs is his two-way VHF radio.

The direction finder can pick up the aircraft radio signal at the range of 40 to 50 mi., but the pilot must be steered to within the 16 nautical mile-range of the radar, before his "blip" appears on the scope. The scope is calibrated in two ranges—0-4 nautical miles and 0-15 nautical miles.

O'Flynn estimates the total set will weigh approximately 1,500 lb. with power supply. He says the set can be brought in for use at an advanced base by one or two large helicopters and set up in a tent within a few hours.

For civilian use, it is anticipated by ANDB that many small heliports will be established with the expected growth of civil helicopter transport traffic, and that similar sets can be installed for their use.

ANA Ready to Quit Flying, Reports Say

(McGraw-Hill World News)

Melbourne—Australian National Airways may be planning to drop out of the airline business, industry observers here again report. Basis for this latest feeling: The carrier is said to be dissatisfied with a government-sponsored plan to alleviate domestic competition between ANA and the nationally owned Trans-Australia Airlines.

ANA reportedly has proposed consolidation of ANA, TAA and some British carriers or a splitup of Australian routes, limiting competition to the Sidney-Melbourne run. Chance of these plans being accepted is understood to be slim.

The private carrier has canceled its orders for Vickers Viscounts, although the government was willing to advance a loan of approximately $7 million to cover purchase of the turboprop transports. There were reports ANA would purchase Bristol Britannias.

Another factor is the strong upsurge of Labor Party power. The party, if returned to power, might abrogate the present ANA-TAA operations setup and nationalize the country's entire airline business.

Aviation Safety

Fresh Approach to Safety Urged

Ben Howard hits stress on crash survival rather than prevention; offers new formula for accident rates.

By Alexander McSurely

A controversial analysis of aviation safety problems is arousing widespread discussion within the aviation manufacturing industry and among civil and military aircraft users.

Ben O. Howard, veteran engineering test pilot and production consultant, bases his provocative safety study on the numerical relationship of accident frequencies to flights made. He contends that the present accepted method of accident analysis—on a basis of hours flown or miles traveled—has very little real relationship to safety factors involved in each flight.

His study shows that only 4.9% of the accidents he analyzed were experienced while cruising enroute, while 95.1% occurred in beginning or terminating the flights.

Because of this ratio, he finds the most realistic accident analysis measures accidents in relation to accident exposures. Each flight, with scant allowance for the length in miles or hours flown, equals one exposure.

▶ **Hits Designs**—Howard contends that it is economically feasible to reduce crash expectancy to less than half of its current level. And he blasts at some specific design shortcomings which he finds are still being incorporated in aircraft, despite blame as accident causes.

(The analysis takes on added significance because of Howard's industry stature. He made the first test flights on many of today's transports and was an early National Air Race winner with planes of his own design, which he afterwards built for commercial sales. More recently, he has used his long industry experience in development, operations and production as consultant to Douglas and Convair and as general manager of Fairchild Aircraft Division, until he returned to the West Coast.)

A paper incorporating Howard's views and explaining his theory was scheduled for presentation at the recent New York meeting of the Institute of the Aeronautical Sciences.

At San Diego, Howard told AVIATION WEEK he withdrew the paper on request of New York Institute representatives after preliminary discussion of the controversy involved and suggestions for deletions. Later he delivered the paper before a San Diego IAS sectional meeting of 100 engineers.

Howard said he wanted to make it clear that he was "not mad at anybody," but that his analysis was based on a careful study over a period of years, and that his material was factual and qualitatively accurate.

Ben O. Howard

▶ **New Formula**—To demonstrate his new formula, he uses as a basis records of 36,500 domestic military accidents experienced in approximately 100 million airplane flights involving 10 billion plane miles and 67,500,000 flight hours. The group analyzed includes 4,200 fatal accidents. He eliminates from the analysis collisions while flying formation and forced landings, neither are probabilities in airline operations.

Of those accidents, his study indicates that only 4.9% were experienced cruising enroute, and that the remainder occurred in takeoff and climb to cruising altitude, and in letdown, landing, taxiing, and other procedures standard in non-local flight.

He challenges "the fallacy of equating safety on a loss per mile or loss per hour basis, instead of the more factual measure of loss per unit of exposure."

On the basis of the formula, he concludes that in the last four-fifths of our domestic scheduled operating experience fatality rates per unit of exposure have been reduced only 10%.

▶ **Airplane Comparison**—Howard deduces from his accident study that crash rates are proportional to the size and complexity of the airplane, and that crash costs for equivalent flight exposure vary as the square of the cost of the airplane.

Replacement of present DC-3 and DC-4 domestic schedules with more modern two- and four-engine planes means an increase in the average crash rate per mile to nearly double, Howard asserts.

On an equal exposure basis, the DC-3, which is unlicensable under today's transport requirements, is by far the safest airline transport in general use today, his deductions indicate. This record casts suspicion on present regulatory safety concepts, he asserts.

▶ **Gust Lock Problem**—Howard cites some of the accidents which have resulted from failure to disengage gust locks, beginning with the first Boeing Flying Fortress Model 299 at Wright Field in 1935, the United Air Lines DC-4 aborted takeoff at La Guardia Field, and the most recent C-124 crash at Larson AFB in December 1952, which resulted in 86 deaths.

As a result of Civil Aeronautics Board investigation of the DC-4 crash at La Guardia, Howard says, "they decided on six items of required corrective action, none of which was even related to a gust lock. Five years later, it was decided to require protection against this hazard but only in new designs and hundreds of DC-4s and DC-3s are still flying without this finally required safeguard."

▶ **Cockpit Controls**—The veteran test pilot asserts that nearly 75% of crashes resulting from misuse of controls in the cockpit could have been avoided if all airplanes were designed with protection against misuse—equivalent to features already found in some airplanes. He estimated that at least a third of all crashes are due to such "misuse."

Any airplane model having a higher frequency of a given-type crash than another model in the same category is below par in design safety, Howard contends.

"It is up to the designers of the aircraft to devise a machine that can safely tolerate the circumstances to which it will be exposed . . . wings to handle the expected airloads . . . and cockpit to safely tolerate the expected performance of the man who is to fly it," he says.

Faulty cockpit design, Howard believes, is responsible for 15 times as many crashes as structural failure, yet there is too great a tendency to leave the responsibility up to the pilot "to read his check list and do things right."

Listed among accident causes which Howard says can be attributed to expecting too much of the pilot's check list are:

- Attempting takeoff with gust lock engaged.
- Failing to put flaps in takeoff position before attempting takeoff.

• Retracting gear before becoming airborne.
• Retracting flaps first instead of landing gear, after takeoff.
• Retracting flaps faster than airplane can accelerate to required flaps-up speed.
• Feathering the wrong propeller.
• Lowering flaps and/or landing gear before plane is slowed down sufficiently.
• Failing to lower flaps or gear before landing.

▶ **Too Fast**—Specifically, Howard cites cases of two transports which crashed as a result of flaps being retracted too soon after power loss on one engine during takeoff.

A decreasing rate in the flap retraction speed or time delay in the flap retraction control circuit would have prevented the accidents.

▶ **Collision Problem**—The veteran test pilot warns that the airplane is the only carrier that does not enjoy a reduction in collision hazard with increase in size of the vehicle. A rowboat cannot sink the Queen Mary in a collision, but a single-place plane can and has destroyed a B-36.

Designers must consider that to provide the pilot with anything less than the visibility of a pedestrian and the dodging ability of a jack rabbit is to increase collision risks, he says.

▶ **Number of Crew**—Howard believes that safety improves in ratio as the number of crew members operating an airplane decreases. Ultimate safety goal for him is an airplane designed for one-man operation of all things affecting safety. He feels that, except for cockpit chores such as operating air conditioning, the crash probability goes up in proportion to the number of people helping to fly the airplane. He asserts that records will support his arguments that the expectancy of crashes is increased when the operation of an airplane requires the assistance of a flight engineer or third crew member.

▶ **Design Details**—Designers should be required to watch more closely installation of control cables, airspeed and altimeter pressure systems, electrical trunk terminals and such things to prevent their inadvertent unsafe assembly. Cited are instances of reversed elevator trim tab cables, reversed aileron cables, and reversed airspeed-altimeter pressure lines.

▶ **Fire Prevention**—Howard wants more emphasis on design for fire prevention rather than heavy emphasis on detection and control. Fire resistant hydraulic fluids and minimum necessary pressures in the fuel lines from tanks to engines, and confining fuel to external tanks which will be thrown clear of the airplane by a high rate of deceleration are urged. He considers such items of greater importance than insisting that the passenger snuff his cigaret when the "no smoking" sign goes on.

He reports one case where a short circuit in the "no smoking" sign in a transport caused a serious fire and major damage to the airplane.

▶ **Crash Protection**—Similarly, Howard feels that recent emphasis on crash survival is disproportionate to emphasis on prevention of crashes. He asks for re-examination of the backward-seating proposal.

Gains that would be made by a recent airline decision to reduce the number of passengers (United DC-4) to improve chances of survival are minor, Howard indicates, compared to what could be done by attention to design to eliminate the occurrence of fire and crash.

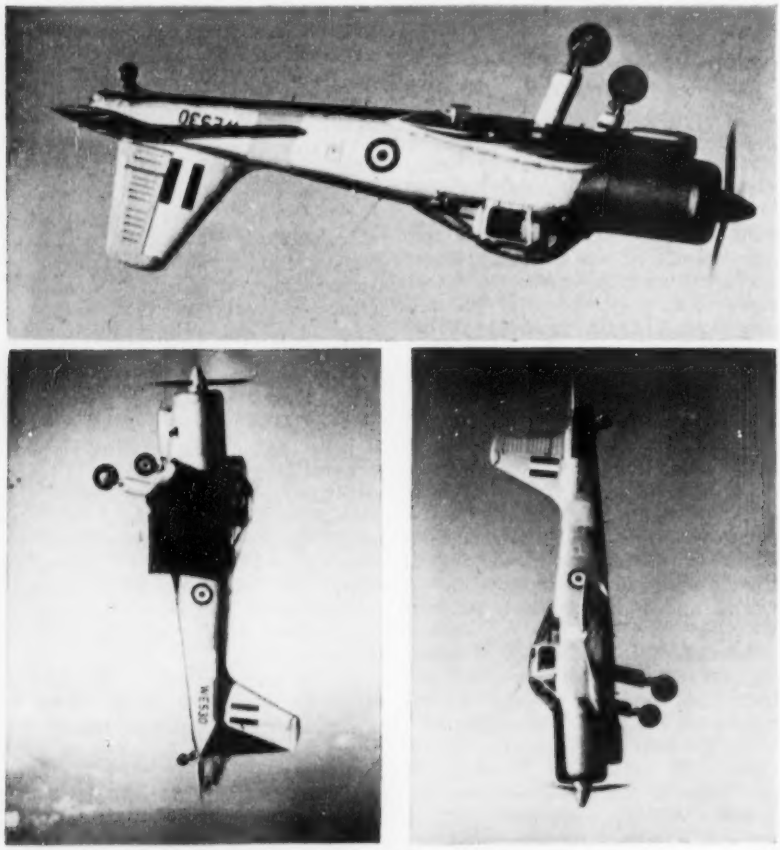
He calls for a change in regulatory agency psychology.

"At present," he says, "they are much more concerned over whether or not a safe flight is possible, than they are over whether or not it is probable. They make more fuss over the effects of humidity on a takeoff than over effects of locked controls, more to-do over the takeoff flight path with flaps than over the position the flaps are in during takeoff."

Risks in pilot familiarization flights, such as flaps-up landings and feathered propeller flights, are criticized by Howard as unnecessary hazards which increase air accidents. He cites crashes of three large transports resulting from such practices.

He suggests as a remedy that pilots could practice poking their finger at "red spots painted on the hangar wall" without "the thrill of living dangerously while poking the red feathering button."

And he urges the importance of careful screening of pilots, suggesting that Air Line Pilots Assn. "assume the moral responsibility of maintaining the proficiency and safety of their active membership at the highest possible level."



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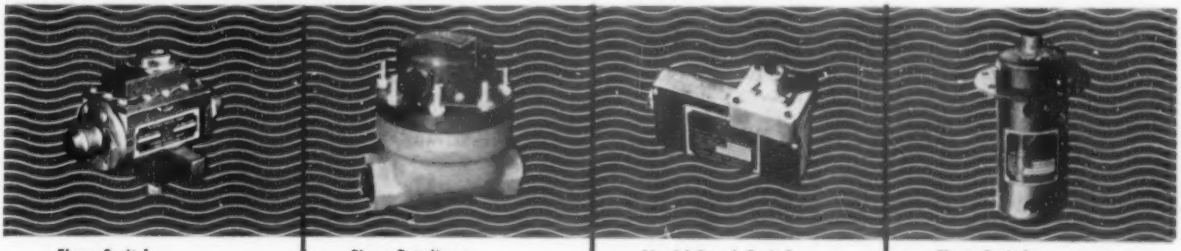

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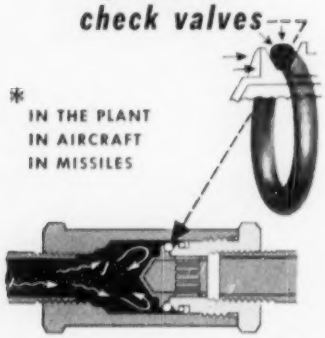

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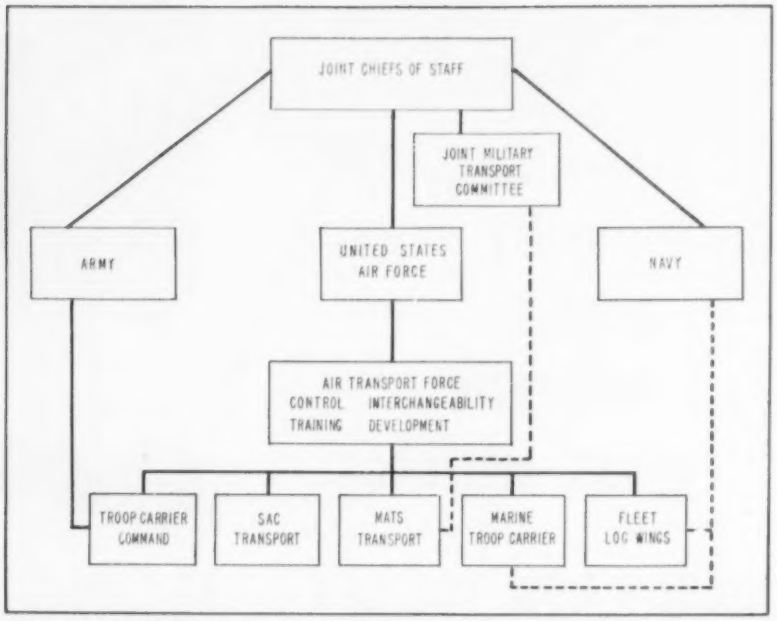


NEW ORGANIZATION of armed forces air transport commands proposed by Maj. Gen. Tunner combines units into a single force under the Joint Chiefs of Staff.

Military Airlift Merger Urged

Cargo expert says air transport resources must be pooled to avoid supply shortage, scattered planes.

A new concept for the organization and utilization of military air transport is advocated by Maj. Gen. William Tunner, deputy commander of the Air Materiel Command and famed airlift expert of the China hump, Berlin airlift and Korean combat cargo.

Generated primarily from his experience as commander of the Combat Cargo Command in the Korean war, Gen. Tunner's concept calls for merging of all military transport resources into a single air transport force operating under specific priority mission set by the Joint Chiefs of Staff. His views were expressed in the latest edition of the Air University Quarterly Review, an official USAF publication.

▶ **Scattered Transports**—"During the past several years there have not been sufficient transport planes available to handle all our airlift requirements," Tunner wrote. "Planned production and procurement programs indicate this condition will exist well into the future.

"To get maximum utilization of the limited air transport equipment available at this time, all of the limited air transport capabilities must be used in the best interests of the country as a whole. Air transport today is scattered among many commands of the Air Force as well as the Navy and Marine Corps, all of whom do not have the same standards of utilization and priority urgency for their use.

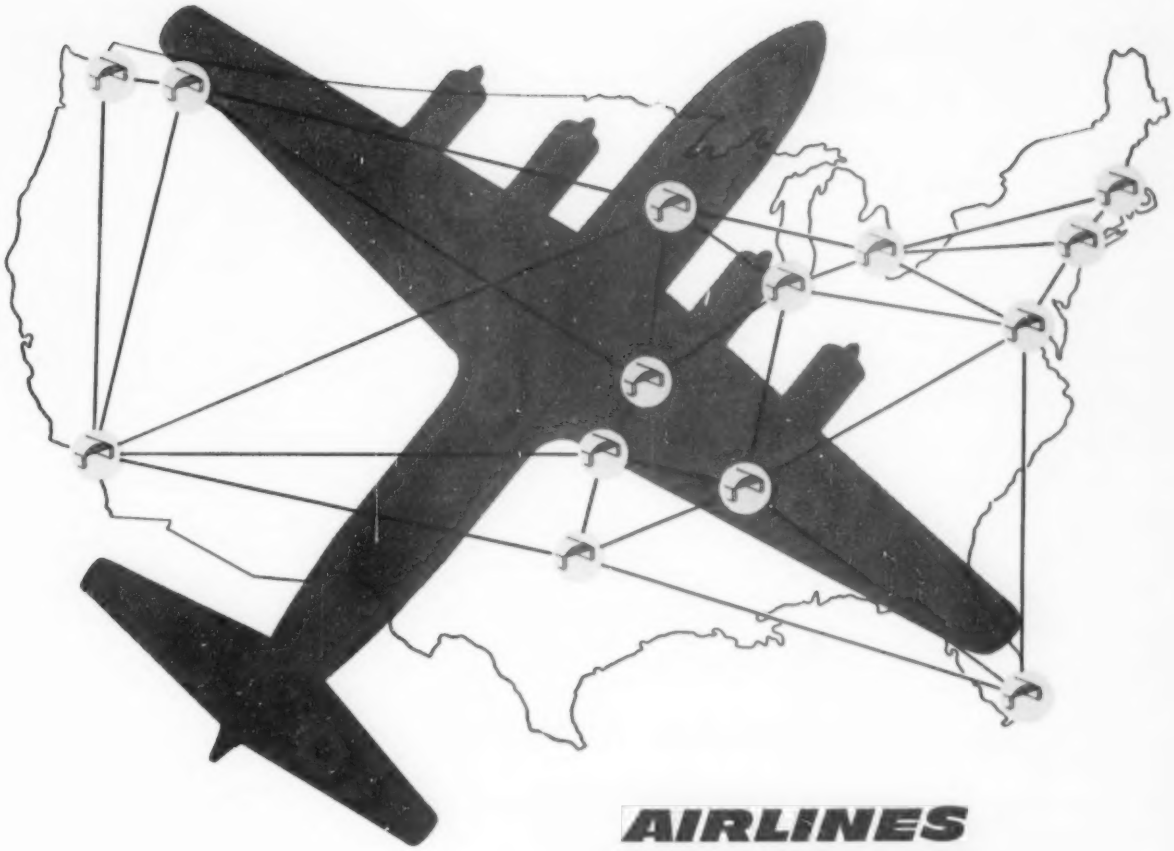
"I feel the consolidation of these aircraft into a single command is the most efficient way to do the job. The single command would be charged with the responsibility for airlift according to the urgency of requirements of all the armed services—in other words, the first needs of the nation. . . ."

▶ **Transport Shortage**—"Today and in the foreseeable future, instead of an abundance of air transport, we will have this vital elen ent in short supply," Tunner said. It is most important that our priority system for its use include all the air transportation available and that its product be made available, according to the situation, to the Army, Navy or Air Force or civilian agencies.

"I believe that this necessity for a single organization cannot be overstressed. Unless this can be achieved, our air transport resources will be frittered away in small packages."

Gen. Tunner said organization of the single air transport organization—which will include transports now assigned to Strategic Air Command, Troop Carrier Command, fleet logistics support wings, MATS and Marine air transports—should be based on providing three types of airlift:

- Local services within the United States.
- Trunk lines connecting local services



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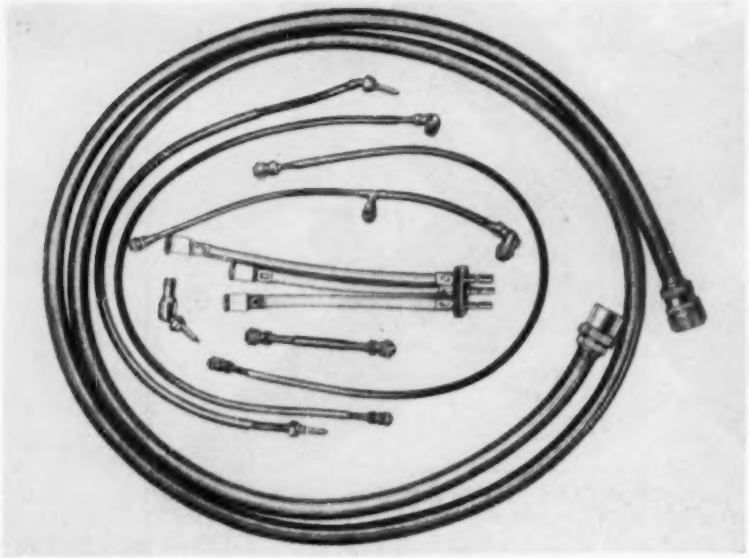

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▶ **Transport Requirements**—Aircraft to meet these requirements should be designed to be tough and rugged (without fancy fittings), easy to fly, easy to maintain with ample cubage and a low ton-mile cost. For the local services, Tunner recommended that the current troop-carrier types be used. Trunk line operations would use aircraft in the 10- to 25-ton category with a normal range of 1,500 mi. For the longhaul work, larger aircraft are needed with low ton-mile costs.

All of these operations should use the same facilities and should be closely integrated under a single management, Gen. Tunner urged.

His concepts are based on the organization and operations of the Korean Combat Cargo Command and its successor, the 315th Air Division (combat cargo), in the early days of the Korean war when all transport resources in the Far Eastern Theater were merged under a single command and executed missions on priorities established directly by the theater commander. Strong opposition to the Tunner plan can be expected from the Navy, Marines, and USAF commands such as SAC that now maintain their own air transport organization.

SEC Reports Wilson, Talbott Stock Sales

Defense Secretary Charles E. Wilson, former president of General Motors Corp., received 603 shares of GM stock in January as compensation for services rendered in the past, the Securities & Exchange Commission reported last week in its monthly official summary for February.

Wilson later sold his total 18,470 shares in the corporation as he did the 21,000 shares of stock in GM Shares, Inc., a holding company and GM subsidiary, as he assumed his new post in Washington. Undersecretary of Defense Roger M. Kyes, former GM vice president, acquired 389 shares of GM stock in January as compensation for past services also. He later disposed of his total holdings of 2,842 shares in order to take up his new post.

Air Force Secretary Harold E. Talbott is reported by SEC as having disposed of 1,500 shares of common Madison Square Garden stock in January, his total common stock holdings as a director of the Garden.

Edward B. Newill, GM director and general manager of Allison Division, received 263 shares of GM stock in January as compensation, giving him total

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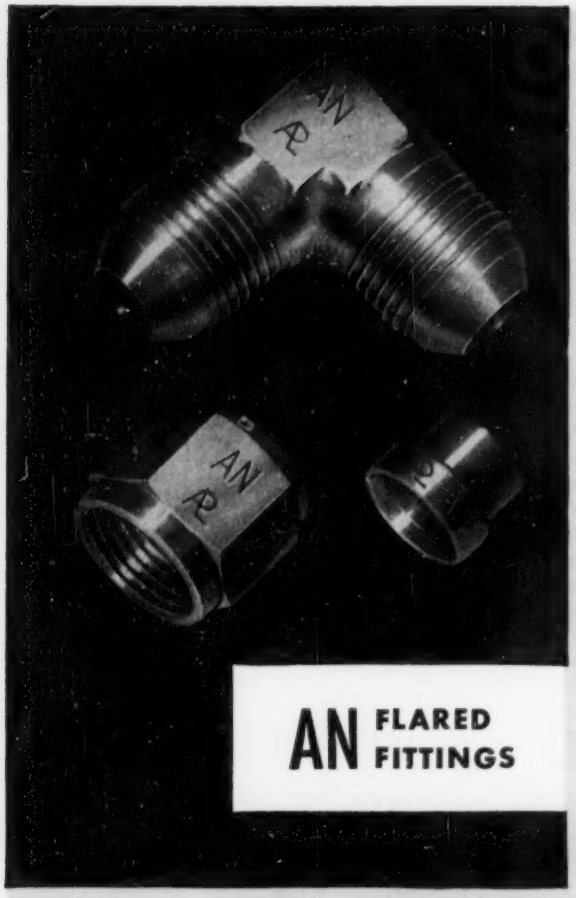

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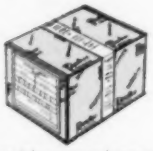

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holdings of 4,608 shares. He also holds 1,245 shares of GM Shares, Inc., SEC reports.

Other aviation stock transactions reported by SEC:

• **Air Associates, Inc.:** Hillsboro Plantation, Inc., bought 3,700 common shares making a total holding of 108,526 shares; Earl M. Newlin, director, sold his total holdings of 1,396 held in trust for his son.

• **Airfleets, Inc.:** Atlas Corp. sold 34,601 shares leaving a total of 7,640; Oswald L. Johnston, officer and director, received 114 common shares as a dividend from Atlas Corp., making total holdings of 2,715; and Floyd B. Odlum, president and director of Atlas Corp., received 1,798 common shares as a dividend from Atlas giving him total holdings in airfleets of 15,998 shares.

• **American Airlines, Inc.:** Charles R. Speers, officer, bought 200 common shares making a total of 3,200 shares.

• **Aro Equipment Corp.:** A. N. Abelson, officer, bought 1,300 common shares making a total of 2,202 shares; Ralph A. Bard sold 500 common shares leaving him 2,800 common shares.

• **Avco Mfg. Corp.:** Judson S. Savre, officer, bought 12,500 common shares giving him total holdings of 13,500 shares.

• **Beech Aircraft Corp.:** Olive Ann Beech, officer and director, holder of 16,050 common shares, received and sold in the same month 4,000 common shares received as trustee from an estate.

• **Capital Airlines:** William V. Couchman, director, sold his 200 remaining common shares.

• **Chicago & Southern Air Lines, Inc.:** Sidney A. Stewart, officer and director, sold 900 common shares leaving a total of 1,600.

• **Colonial Airlines, Inc.:** Francis Hartley, Jr., director, sold 500 shares of common, leaving a total of 3,300 shares.

• **Consolidated Vultee Aircraft:** LaMotte T. Cohu, officer and director, sold 1,960 common shares leaving a total of 700 shares.

• **Continental Air Lines:** Sheldon G. Cooper, director, bought 400 common shares making a total of 2,000 shares held; Frederick L. Ehrman, director, sold through Lehman Brothers 3,638 common shares leaving him a total of 1,100 shares.

• **Eastern Air Lines:** Charles Froesch, officer, bought 100 common shares making total holdings of 905 shares; William Van Dusen, officer, through employe stock purchase plan, bought 2,200 common shares, his total holdings.

• **Flying Tiger Line, Inc.:** Samuel B. Mosher, director, sold 150 common shares leaving 26,895 total holdings.

• **Lockheed Aircraft Corp.:** Daniel J. Haughton, officer, sold 300 capital shares with 1,690 remaining; Willard W. Keith, director, bought 120 capital shares making total holdings of 1,000 shares.

• **McDonnell Aircraft Corp.:** William R. Orthwein, Jr., officer and director, bought 100 common shares giving him a total of 5,300 shares.

• **National Air Lines, Inc.:** John W. Cross, director, bought 200 common shares making a total of 500 shares; Erwin J. Kershaw, officer, bought 1,950 common shares making a total of 2,350 shares.

• **National Aviation Corp.:** Frederick F. Robinson, president, sold 100 common shares leaving a total of 300 shares.

• **Northwest Airlines, Inc.:** Morton H. Fry, officer and director, bought 100 common shares making a total holding of 200 shares.

• **Pan American World Airways, Inc.:** Franklin Gledhill, officer and director, received 246 capital shares compensation making a total of 2,479 shares; Wilbur L. Morrison, officer, received 619 capital shares compensation making a total of 9,569 shares.

• **Piper Aircraft Corp.:** Walter C. Jamouneau, officer and director, sold 100 preferred shares, leaving him 700 shares.

• **Roosevelt Field, Inc.:** Paul E. Peltason, director, sold his 676 common shares held indirectly through a partnership. He holds 2,000 direct shares; Webb & Knapp, Inc., bought 300 common shares making a total holding of 47,790 shares.

• **United Air Lines, Inc.:** Justin W. Dart, director, sold 1,000 common shares leaving a total of 19,000 shares still held; Otis E. Kline, officer and director, sold 200 common shares leaving 7,500 total; and S. P. Martin, officer, sold 100 common shares leaving 400 common shares.

• **United Aircraft Corp.:** William Gage Brady, Jr., who recently resigned as a director, sold his total holdings of 150 common shares.

• **United Aircraft Products:** Edward L. Ladd, officer, bought 400 common shares making a total of 1,900.

Canadair May Build Britannia for RCAF

Construction of Britain's Bristol Britannia in Canada by Canadair, Ltd., is still a strong possibility. Discussions—which began about six months ago between the Royal Canadian Air Force, Bristol Aeroplane Co., Ltd., and Canadair—still are continuing in Ottawa, Montreal and Filton, England.

If the RCAF does acquire the Britannia, chances are that Canadair will build the transport as an over-water reconnaissance plane for long-range, low-level operation. The order would have to be substantial, considering the cost of producing an airplane of this size.

In its present configuration, the Britannia is powered by four Bristol Proteus 705 turboprops. But for RCAF service, it is likely that a different powerplant would be used. Reports are that Wright Aeronautical's R3350 Turbo-Compound engine is being considered in connection with the RCAF Britannia version.

▶ **Civil Production**—A strong possibility if RCAF orders the transport is that Canadair seriously will consider constructing the Britannia as a civil airliner after the reconnaissance version orders have been filled. A market for this civil version might be found with Trans-Canada Airlines, which has not shown any great interest in the Comet.

Another Canadian market for the civil Britannia might be the RCAF itself, to replace North Stars (C-54s) now used as transports by Canada's air arm.

▶ **USAF Production**—Meanwhile, Canadair is turning out F-86s and T-33s for the RCAF. About six of the latter craft already have rolled off the production lines.

On its U. S. Air Force T-36A project for Beech Aircraft Corp., Canadair has built and shipped the rear fuselages and outer wing sections for the three preproduction planes Beech is to assemble at Wichita, Kan.

For its regular T-36A production under Beech license, Canadair will assemble the entire plane, building the forward fuselage, center wing and powerplant package forward of the firewall, and subcontracting the rear fuselage, empennage, outer wing panels and aft portion of nacelles.

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Aircraft Design in Transition

This is a time of transition in aircraft design.

The ideas that were developed to speed World War II toward its conclusion have about outlived their usefulness. The nebulous dreams of automatic fighters, pilotless bombers and long-range jet transports have yet to become tangible stuff.

So designers everywhere are facing the problems posed by interim types, types which must combine the better features of missile and airplane, of piloted and pilotless flight, of conventional and new construction.

Spurred on by the undefined implications of the Korean conflict, these engineers are looking at new ways to reach the tough performance goals set by the requirements of the jet era.

These advanced ideas cut a swath across drawing boards from layout to detailing. They embrace new aerodynamic concepts, advanced structural makeup, and powerplant innovations.

Some of these schemes—the hydro-ski, the by-pass engine, the crescent wing—were reviewed in the issue of Nov. 17, 1952, p. 21. With this article, Aviation Week's Engineering Editor, David A. Anderton, continues his analysis of what lies ahead, with discussion of design and engineering needs of tomorrow's fighter-interceptor.

The Interim Interceptor: An Analysis

- **How will engineers link today's piloted fighters and tomorrow's automatic craft and guided missiles?**
- **Some predictions: with tailless deltas, turbojets plus afterburners, and integral design.**

By David A. Anderton

Here is how new ideas could change the face of tomorrow's aircraft designs. For one specific example, take the fighter-interceptor.

A typical interceptor mission can be defined simply; it is the execution of the mission that calls for complex techniques.

Once alerted, the intercepting aircraft must take off immediately, climb towards its target, find it and destroy it. The plane must be able to perform this mission in any kind of weather, in any climate, by night or day.

Because rate of climb and destructive power are prime adjuncts to such a mission, an interceptor is going to be light and carry heavy armament. Finding the target and tracking it will require lots of avionic equipment. Rapid take-off and climb will demand a high-thrust powerplant.

So the designer's problem is to take all these items, add a well-protected pilot to monitor the whole procedure and to take over if and when machines fail, and enclose the works in the smallest possible package.

It's the packaging job that poses the first problems.

▶ **How to Begin**—In times past, the designer has had some kind of an idea as a starting place—an airplane shape that has been well proven over the years, or a favorite French curve for the fuselage lines. There may have been restrictions on components use; some wing panels from an earlier fighter could be adapted. Or a whole airplane may have been selected and modified until only faintly recognizable.

But tomorrow's designer may have to wait for the answer from a computer.

Suppose that the design is being developed to counter a particular class of high-altitude bomber with high subsonic speed. Instead of going through the cut-and-try procedure which has so long been typical of design practice, the target characteristics and sets of typical interceptor characteristics are fed into a computing machine which grinds out the type or types of interceptors that will be able to shoot down the target.

The computer does not design these airplanes, but merely specifies that with such a powerplant you will need such a wing loading and such a minimum drag coefficient, and so on.

Convair has done this kind of a study for families of bombers, and has developed a huge reference frame of parameters from which can be taken a set of characteristics to solve any particular requirement. The same technique could be applied to the selection of any type of aircraft.

▶ **Aerodynamic Shape**—About here is where the aerodynamics team will get called into the picture. They will have two major problems: First, to select the correct wing shape and therefore determine the aerodynamic layout, and second, to select the proper kind of inlet and ducting for the engine air.

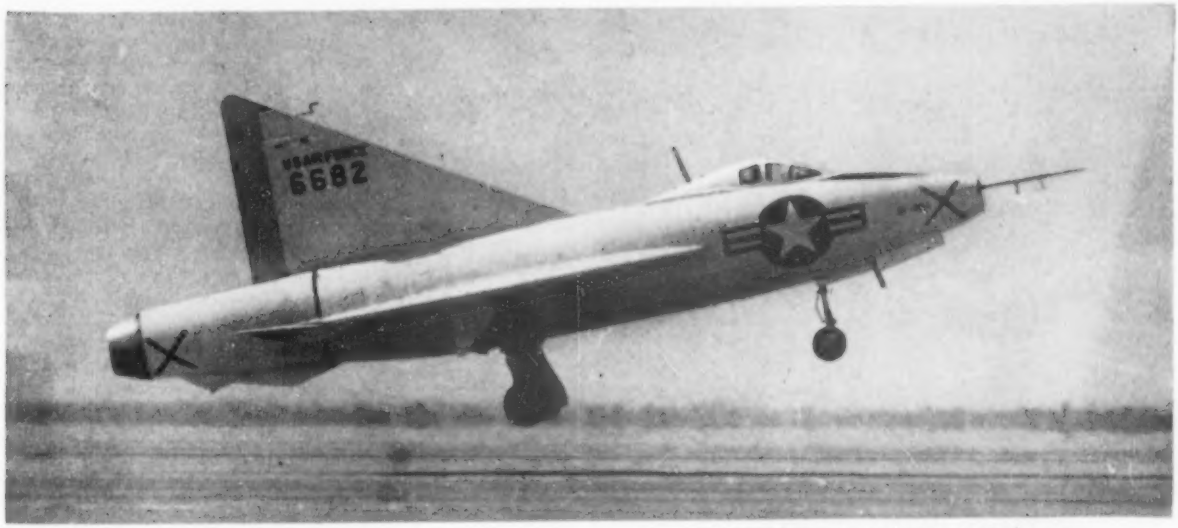
In wings, there is not much choice. The criterion is thinness, and you can get a thin wing today in straight, swept or delta form. Company practice will have something to do with the choice, and availability of production tooling will also have a bearing.

But there is no doubt that the delta will receive a large share of the attention. Acceptance of the delta layout was the outstanding feature of the year just past (Aviation Week Mar. 2, p. 154).

There are indications that the upcoming generation of fighters will depend heavily on the delta wing—or a near-delta shape of high sweep angle—for knifing through sonic speed into the low supersonic range. There is a further advantage, borne out by weight studies made here and abroad: The delta wing can be built stronger and stiffer for the same weight of structure than other wing forms.

▶ **Tailed or Tailless?**—There are two schools of thought on the question of horizontal tails used with a delta layout. In England, proponents of the delta point out that you need a tail for precise control and maneuverability. Thus a tail appears on the Gloster Javelin all-weather fighter and does not show on the Avro 698 four-jet bomber, which presumably would not be called on to perform the gyrations a fighter would.

In the United States, proponents of the delta have produced fighters without horizontal tails—Convair F-92A,



CONVAIR XF-92A is possible archetype of future U. S. interceptors combining small size, delta wing and jet with afterburner.

F2Y-1 and the Douglas F4D-1—which are expected to be maneuverable and precisely controlled.

But a horizontal tail undeniably adds weight, due first to its own structure and second to the additional structure required to mount and carry its loads. The high Tee-tail shape in favor for the tail layout is a natural for flutter troubles.

So the trend in this country is to leave the tail off.

▶ **Letting Air in**—There isn't much choice about air intakes for the fighter. The requirement is that the inlet be as close to the bow of the craft as possible. The pitot entry of the F-92A and the F-86 Sabre are good examples.

But you have a lot of radar for the nose of this interceptor and so the direct inlet may not be practical. Maybe you want to undersling the intake, as North American has done with the F-86D. Or you might go to cheek-or-jowl entrances like those developed on the North American F-93A.

At one time, NACA and others were interested in the problem of rear inlets for highspeed fighters. These were generally simple types, located toward the fuselage stern.

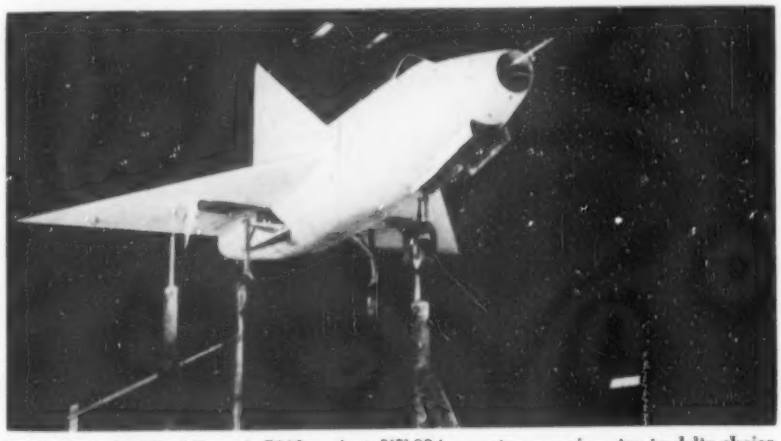
One example was used by Avro in the 707 and 707B delta test vehicles. But everyone, including Avro, was aware that the location works against any kind of decent pressure recovery in the engine and the rear inlet was abandoned.

It seems as if the interceptor will have either an underslung intake or a cheek-or-jowl pair of inlets.

▶ **Powerplant Choice**—The designer needs an engine with high thrust and light weight and here the choice is a difficult one.

Lightest engine per pound of thrust is the rocket engine; but the weight of engine plus fuel to supply high thrust

REPUBLIC XF-91 with powerful rocket motors and jet plus afterburner is another approach.

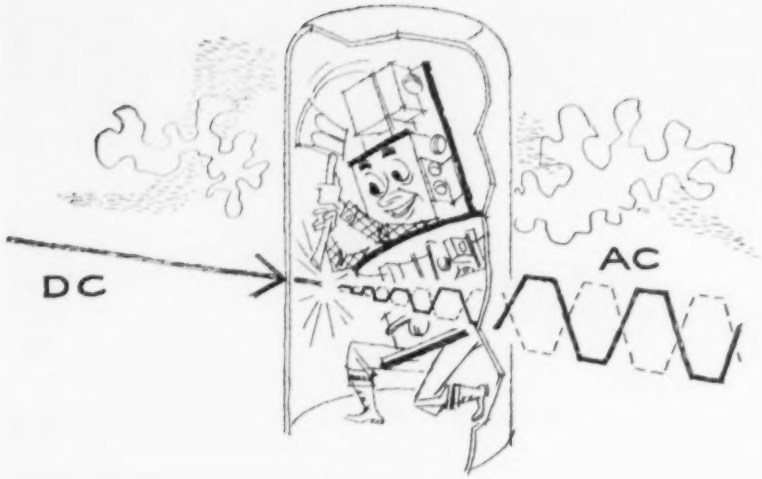


TUNNEL TESTS of Convair 7002 project, XF-92A ancestor, gave impetus to delta choice.

over even a short period of time is appalling. Assume a 10-min. mission with a 10,000-lb.-thrust rocket motor. You will calculate that the fuel needed is something like 30,000 lb.

Further down the thirsty scale is the ramjet. Let us assume the same mission time and thrust and add in sonic speed. Fuel might then be about half the rocket figure, around 15,000 lb.

With a turbojet plus an afterburner, the fuel consumption can be reduced further and the total fuel load for the mission might then drop to around 3,000 or 4,000 lb. Then adding in the weight of the turbojet itself plus the afterburner, you might end with a total powerplant installed weight of about 10,000 lb., less than the fuel weight alone for the ramjet and well under



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Here are some of the other characteristics of the little "chopper":

1. **It's versatile,** can be used as a DC-AC modulator, or as a rectifier.
2. **It's longer-lived,** operating for an average of 500 hours.
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4. **It's tough.** When shock mounted (in any position) it exceeds rigid Air Force environmental specs.
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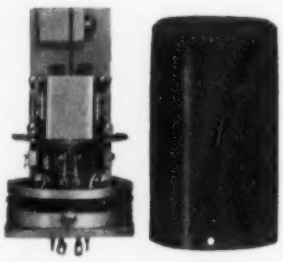
If you'd like to know more about the WG-178 Synchronous Vibrator, we'd be pleased to send details. The address is Honeywell Aero Division, Dept. 401(AW), Minneapolis 13, Minnesota.



Specifications for Synchronous Vibrator WG-178

Coil Supply: Suggested supply voltage is 115 volts, 400 cps for WG-178A and 12.6 volts, 400 cps for WG-178B when suitable voltage-dropping resistors are included in the circuit with the field coil.

Power: Approximately 0.7 watts, excluding the phasing circuit.

Contact Rating: Contact rating depends on circuit in which units are used. All applications should be referred to our engineering department for approval. The devices have been used in circuits with approximately one milliampere (nominal) current and up to 35 volts dc supply.

Environment: When used on a shock-mounted chassis type mounting the units conform to Spec 41065B as called for in AF27500D as follows:

Humidity Test: 10 day (24-hour cycle).

Temperature Test: -65°F. to 160°F. (-54°C. to 71°C.).

Altitude Test: 55,000 feet.

Vibration Test: Up to 200 cps (5G maximum). This is a modified test.

Sand and Dust Test: As specified.

Mildew Resistance Test: 28 days.

Salt Spray Test. 50 hours.

Weight: Approximately 0.5 lb.

MINNEAPOLIS **Honeywell**

Aeronautical Controls

that for the rocket-type powerplant.

To strengthen the choice, remember that there is little subsonic ramjet experience in this country outside of the Marquardt people, and that the 10,000-lb.-thrust turbojet plus afterburner is practically at hand. Since tomorrow's fighter is being designed today, the choice is obvious.

The future manned interceptor will use a turbojet plus afterburner.

There is a possibility that you could make a good case for the system recently exemplified in the French Sncaso Trident, which is powered by two small Marbore turbojets in wingtip nacelles and a huge rocket engine in the fuselage. Thrust of the two Marbores totals around 1,700 lb.; the rocket is reported to have a thrust of 9,000 lb.

In this airplane, the major portion of the mission—the outgoing leg—would have to be performed on rocket power. Coming back, the airplane would be very light and could fly on the Marbores without being underpowered.

Republic's XF-91 interceptor is a strong argument for the combined turbojet-plus-rocket powerplant. But supplying the fuel is still a problem when you have a thin wing and a fuselage full of engine.

It isn't a trend, but it is a possibility that tomorrow's interceptors will use auxiliary rocket engines.

► **Pilot Office**—The whole problem of designing living space for the pilot is one that is beginning to occupy some of the best design, research and medical minds in the country.

Basically, the pilot can either sit or lie prone. In either case he must have comfort, visibility, protection and survival means.

There are advantages to both systems. A pilot can see better if he is sitting up, and take G loads better if he is lying down. Almost all of our past experience in protection and survival has been with seated pilots; current equipment like the new pressure suit and ejection seats are designed on that basis.

One of the big reasons advocated by proponents of the prone position is the reduction of drag and the reduction of windshield problems. But nowadays the engine is so big that a man can almost be fitted within its front-view silhouette. The windshield of the Douglas Skyrocket has not been reported as a trouble-maker, and its influence can be seen in the canopies of the Convair Sea Dart and the Douglas F4D Skyray.

The pilot will fight tomorrow from a seated position, it appears.

► **Weapons**—The remaining big design parameter in the interceptor is its offensive battery. Here the designer is walking into one of the biggest fights in the services. There are four choices: machine guns, cannon, unguided rockets

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and guided missiles. According to the advocates of each system, each is the best.

But which way is the wind really blowing?

Today's top fighter, the F-86 Sabre, is holing MiGs with .50 cal. machine guns with an effective gunsight system doing the "dog work." That seems to be the obvious clue—it's the system that counts, and in theory all you need to do is get a single .22-cal. round between the pilot's eyes.

But the current trend is to the unguided rocket as the main battery. About two dozen of the little folding-fin jobs can be packed into a nacelle on the wingtip (F-89D Scorpion) or into an annulus around a radome (F-94C Starfire). They can also be slung in a retractable rack underneath the fuselage belly (F-86D Sabre).

Disadvantage is the lack of terminal guidance, which can be serious because of the dispersion. Apparently the aerodynamic characteristics of finned rockets leave much to be desired. All the available pictures of salvos in the air ahead of the plane show the rounds heading only approximately toward the target.

The answer here is accurate initial guidance, which is the job of the sighting system, and firing at the last possible second to reduce physical dispersion.

▶ **Missiles?**—The air-to-air missile is one of the brighter spots in the missile program. There is a chance that the Air Force will begin to get some of its Falcon missiles this year, and the Navy has announced that squadrons will be equipped with the Sparrow starting very soon.

The size of these weapons is such that a small fighter would be restricted to carrying about four rounds. Right now, you could expect a kill probability of about 50%; thus, two rounds must be fired at each target. This means only two targets per trip.

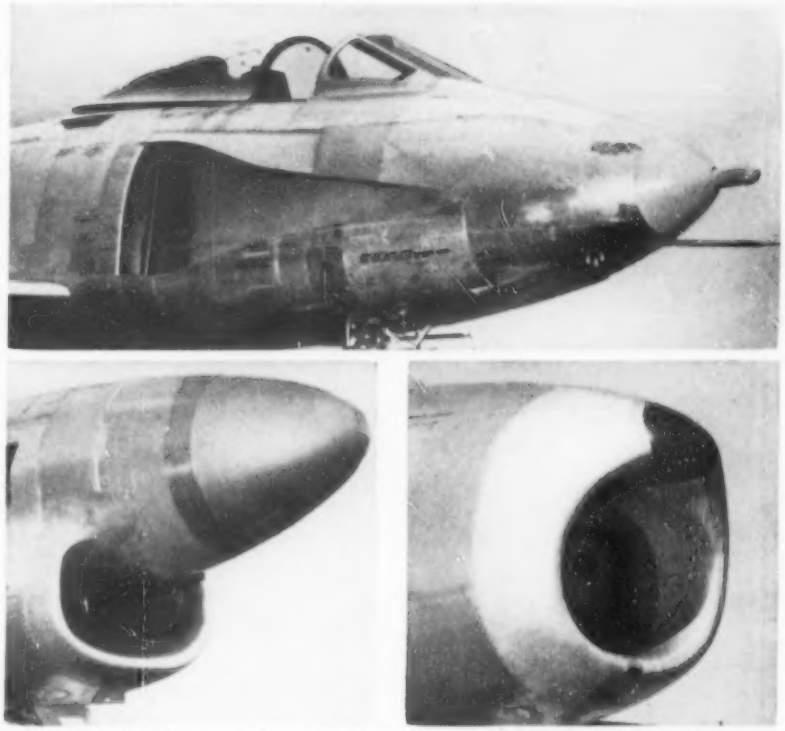
But with the short-mission and few-target philosophy which dictates interceptor design, four missiles should be enough.

Air-to-air missiles should be the main battery of tomorrow's interceptor.

▶ **Details**—With these characteristics roughed out, the design work can begin. Biggest single factor in the detailing of these new airplanes will be the USAF heavy press program.

This gigantic plan is aimed at the eventual production of airplanes by building large integrated components instead of many little bits and pieces. Designers have been quick to appreciate the many advantages which accrue from acceptance of this basic program, and in increasing numbers are beginning to design into the program.

Interceptor aircraft would seem to be a natural type to fit in here, because such planes are generally wanted in quantity. Attrition of aircraft—although not necessarily pilots—might be high, and the actual number of airplanes needed to defend a metropolis adequately is high indeed under these considerations.



AIR INTAKES: Three typical examples from North American's Sabre line typify current practice. Flush inlet (top) or underslung (lower left) are likely choices in upcoming interceptors. Straight pitot inlet (lower right) restricts radar use.

Large integrated components will be the structural backbone of the interim interceptors.

New materials will come in along the way, also. Titanium, the "wonder" metal, will find increasing use; new plastics for primary structure will vie with aluminum and magnesium for the designer's consideration.

Metal adhesives—Metlbond, Redux—will probably not be used in these small aircraft. Chief advantage of the adhesive process seems to come in larger aircraft.

▶ **More Details**—Any such prognostication as this could not hope to get into the myriad details which make up any contemporary airplane. The purpose of this analysis was to rough out some of the major trends which will influence the design of one specific type of future airplane.

There are hundreds of problems in designing the cockpit and the controls, in choosing a landing gear and auxiliary systems.

There are modifications born on the drawing boards, in the windtunnel and on the first flights. But basically, the factors which make it look like a kind of an airplane are the ones which have been considered here.

This is what the final configuration might be:

The interceptor is a delta-winged craft powered by a 10,000-lb.-thrust turbojet with an afterburner. The radar nose has two cheek inlets on either side. The pilot sits in a conventional cockpit under a sharp-nosed, small-paned canopy.

Four miniatures of this airplane are mounted on the wings, a pair on each side. These are the air-to-air missiles which will kill the quarry.

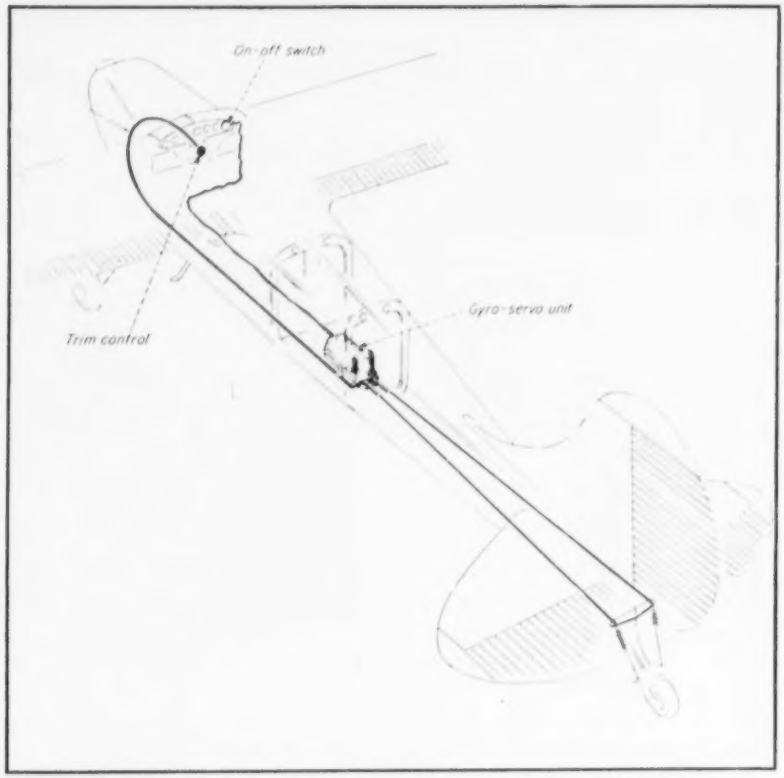
Underneath the smooth skin of the plane are a minimum number of structural parts, formed into shape on one of the big presses, machined at high speed on new production tools.

That's an interim fighter. It might be the Convair F-102 or the next—numerically—product of Lockheed or Republic. Its performance will be supersonic, its size small and its efficiency high. It will still be flown by a man, although he'll have less and less to do as he approaches the target.

After this one will follow the missile, a natural for the job of interception. It has advantages that the piloted craft can never hope to achieve. It could cost less and be operated with higher operational efficiencies.

Meantime we have this interim craft. It marks a transition from piloted planes to missiles. Some day it may be called the last of the fighters.

AVIONICS



ANTI-SPIRAL system has simple cockpit-to-rudder hookup in average lightplane.

'Automatic Rudder' in Production

Javelin's 'autopilot' is low-cost, lightweight unit for keeping lightplanes out of inadvertent spirals.

By Philip Klass

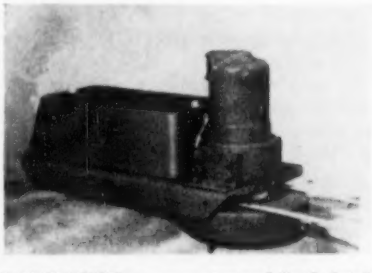
Javelin Aircraft Co. of Wichita has begun delivery of production models of its recently announced low-cost automatic device designed to prevent a lightplane from inadvertently entering a spiral during instrument weather conditions.

The Javelin device, which weighs less than 20 lb. and sells for less than $400, is called a "single-axis automatic pilot" by its manufacturer. However, from an operational viewpoint it might more appropriately be called an "automatic rudder."

By any name, the device has stirred so much interest in lightplane circles that Lear, Inc., has decided to enter the field and is currently designing its own entry (Lear now makes a complete three-axis lightplane autopilot, the L-2).

▶ **The Need**—Under instrument weather conditions, when a lightplane pilot is preoccupied with his charts and radio aids, the plane may drop a wing and slip into a slow converging spiral without the pilot being aware of this condition until too late. According to David Blanton, president of Javelin, 709 people have been killed since 1936 as a result of this "spiral instability."

One popular type of lightplane suffered 23 instrument weather accidents which Blanton says can be charged to spiral instability, because the wing panels were found at distances up to two miles from the location of the fuselage. Blanton concludes that as the spiral began converging, the pilot was blacked out by the increased Gs, allowing the load factor to continue to build up until structural failure occurred.



RATE GYRO, servo motor and fluid clutch all are contained in this small, single unit.

Mooney Aircraft, Inc., plans to make the new Javelin device standard equipment on its new four-place airplane because it offers cheap insurance against structural failure, Blanton says.

▶ **The Solution**—If a lightplane can be kept in straight flight whenever a gust drops a wing, the plane's inherent lateral stability will return the wing to level, thus preventing a spiral. The new Javelin device operates to oppose a change in heading whenever the airplane drops a wing. The device does this by spotting a change of airplane heading and automatically applying rudder to oppose the change.

In a sense, the Javelin device resembles the yaw dampers (used in high-speed jets) more closely than it does a conventional automatic pilot.

The thing that distinguishes a yaw damper from an autopilot is that the former operates from a rate gyro (or accelerometer) to oppose airplane yawing, whereas the autopilot operates from a free-gyro or magnetic compass reference to hold the airplane on a specific heading.

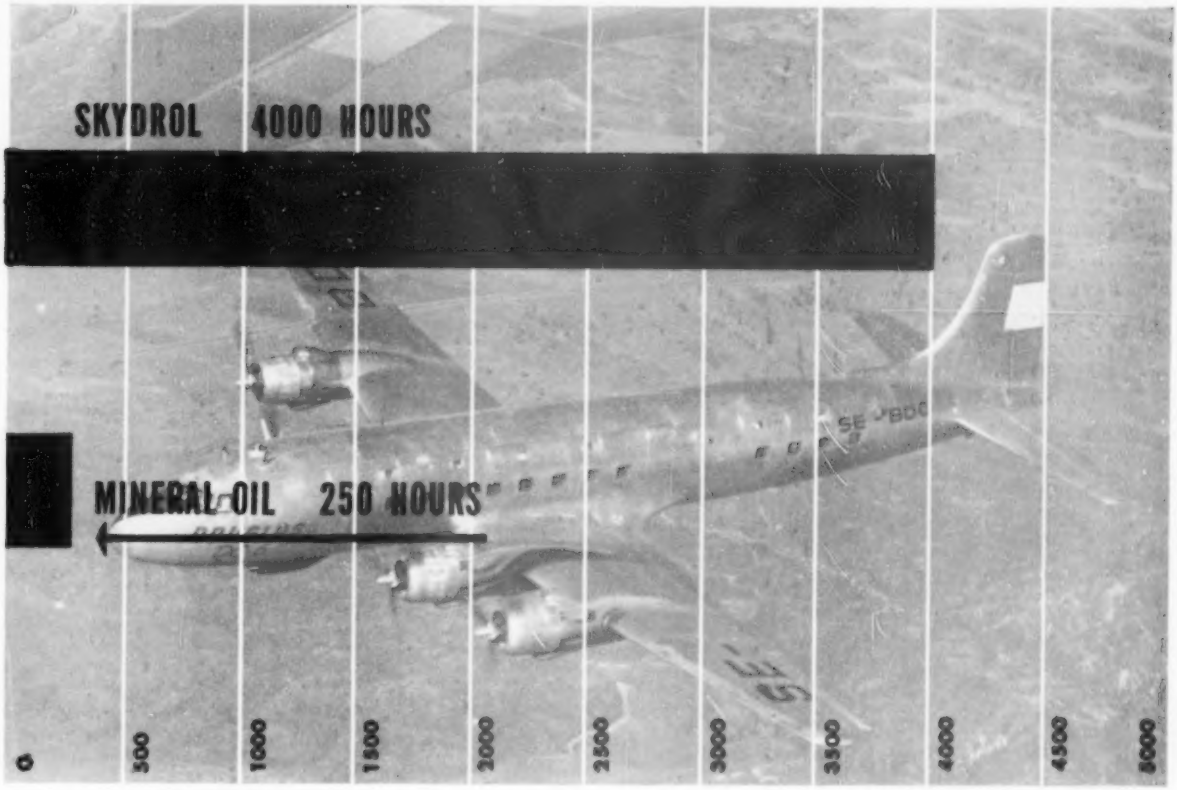
Because the Javelin device uses a rate-type gyro, it cannot maintain the airplane exactly on a pre-set heading in gusty air, although it reportedly holds heading within a few degrees in smooth air. One advantage in using a rate-type gyro is that it is "thumb-proof" and need never be caged.

▶ **In Operation**—In a Javelin-equipped lightplane, the pilot hardly knows the device is present except that the plane exhibits improved directional stability and occasionally the rudder pedals move back and forth.

If the pilot wants to make a large change in heading, he applies a small amount of rudder pressure to overpower the Javelin device. For small changes in heading, Javelin is providing a small panel-mounted trim control that operates through the servo actuator.

▶ **How It Works**—Except for a panel-mounted off-on switch and trim control, the complete "single-axis autopilot" is housed in one unit. This unit contains a rate-type gyro that detects airplane yawing motions, and a d.c. servo motor (and reduction gearing) that operates through a fluid clutch to deflect the rudder control cables.

Instead of using the conventional magnetic or potentiometer-type pick-off on its rate gyro, Javelin uses two sets of electrical contacts. This eliminates the need for an intermediate stage of electronic amplification between the gyro and the servo actuator motor,



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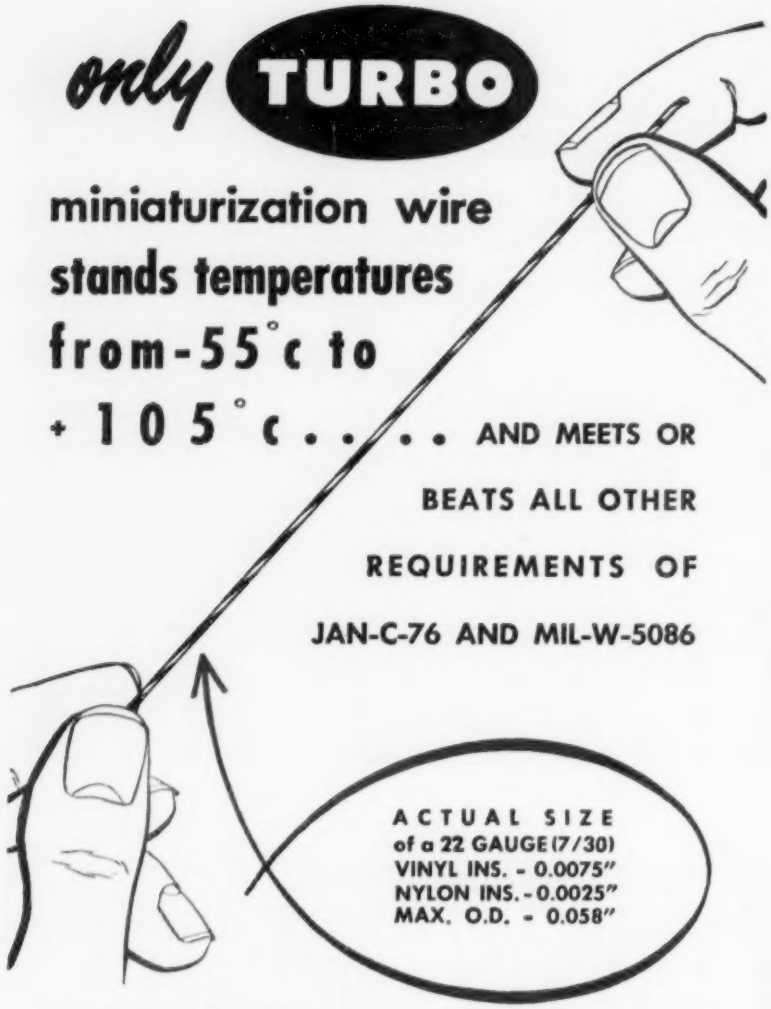

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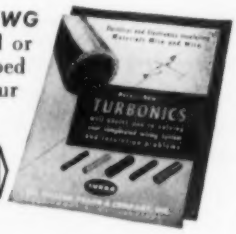

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thereby control cost and complexity.

With any change in plane heading, the gyro closes one or the other of its contacts (depending on the direction of the spiral) which in turn excites one of two motor fields, causing the motor to rotate in a direction to apply counteractive rudder deflection.

► **No Contact Problems**—The use of electrical contacts to control the flow of electrical power to a highly inductive load like a motor field frequently raises problems of contact arcing and pitting. Blanton says that this has not been a problem in his device to date. Javelin guarantees 1,000 hours of equipment operation without maintenance.

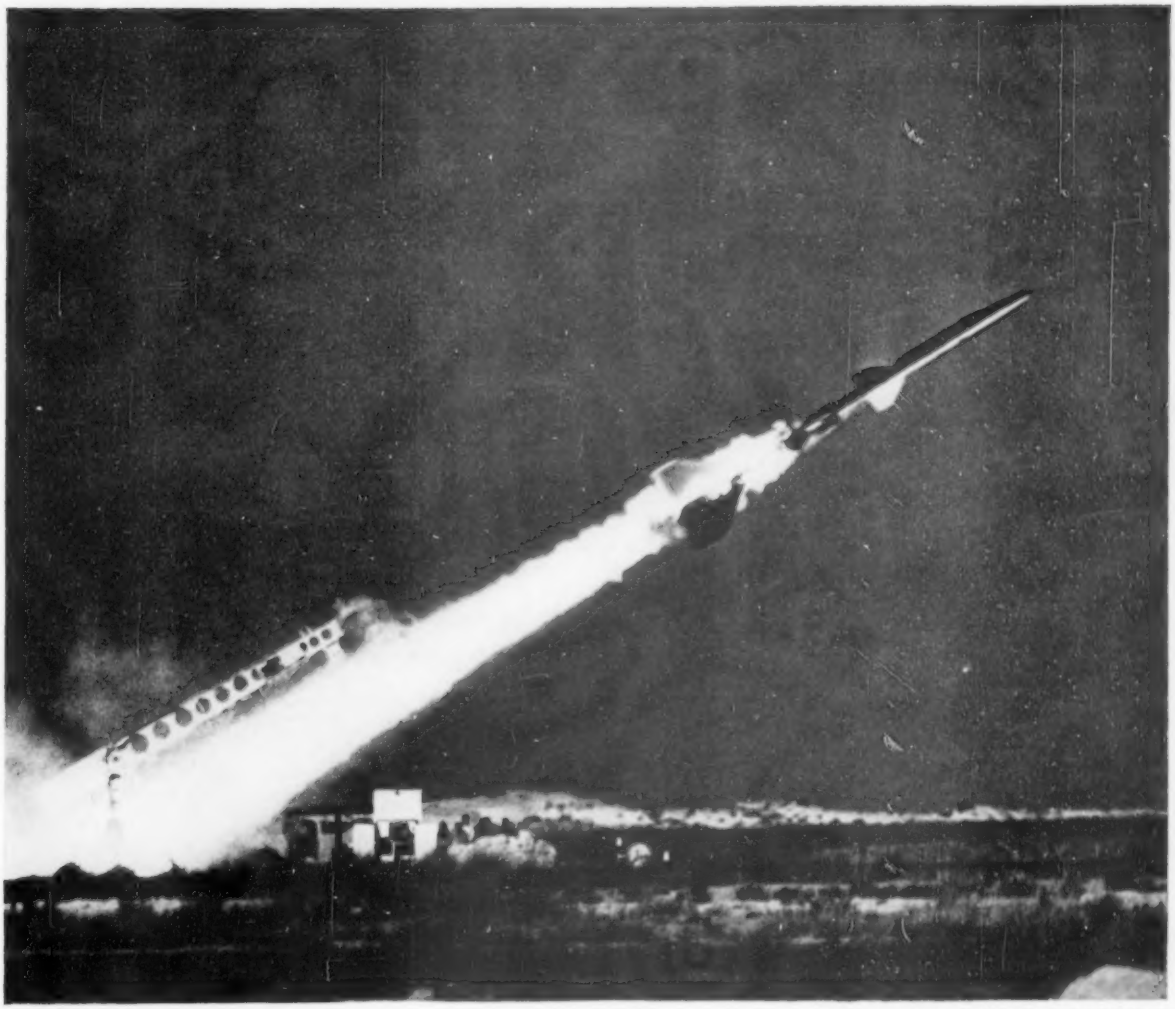
After 1,000 hours, gyro motor brushes will need to be replaced, Blanton says.

► **Future Plans**—Javelin has racked up more than 300 hours of flight time on a Cessna 140 and is currently running tests on a Piper Tri-Pacer which it purchased several months ago. Production of the Javelin device is underway in the Wichita plant recently vacated by Mooney Aircraft Co. when Mooney moved to Kerrville, Tex.

Javelin says that it expects to obtain CAA certification for use of its device with all popular makes and models of lightplanes. This will enable a licensed field mechanic to install the autopilot and merely record same in the log book. For non-listed airplane types, a Form No. 337 (Repair and Alteration) must be submitted for CAA approval.

FAR EAST MICROWAVE

Maj. Gen. Paul E. Ruestow, commanding general of the Far East Air Logistic Force, makes the first test call on a Philco 24-channel microwave transmitter recently installed at the 6400th Air Depot Wing in Japan. Microwave networks, which are coming into wider use in both military and civil aviation, save the installation and maintenance expense of land lines.



*A Boeing test missile at instant of firing**

This rocket missile writes a story of the future

With a shattering roar, a test project guided missile takes off for the black silence of space. Its intricate electronic equipment broadcasts data of vital importance back to earth.

Boeing engineers were among the earliest to be assigned a guided missile project at the end of World War II. Their work, which demands a great variety of specialized engineering backgrounds, now goes far beyond research and design on missiles themselves. It includes the development of complete systems for air defense.

Communications, logistics, maintenance, co-ordination, bases – these are just a few of the many sub-areas of Boeing's over-all activities in this field. In addition, Boeing monitors the activities of numerous sub-contractors whose work is part of this larger, more comprehensive developmental program.

Sound research, design and engineering have distinguished a long line of Boeing aircraft. Today the same sincerity and imagination are dedicated to a broad developmental program on air defense systems. At the same time the company is building the swift B-47 six-jet medium bomber and the great new B-52 eight-jet heavy bomber. On their own – or considered with air defense systems – such strategic bombers are strong deterrents against attack.

Whatever Boeing develops and builds, you can depend on its integrity.

*Firing of one of more than one hundred GAPA missiles built by Boeing is shown. These missiles reached speeds of more than 1500 miles per hour. The GAPA project, concluded in 1949, provided valuable knowledge now being utilized by Boeing in a new advanced air defense program.

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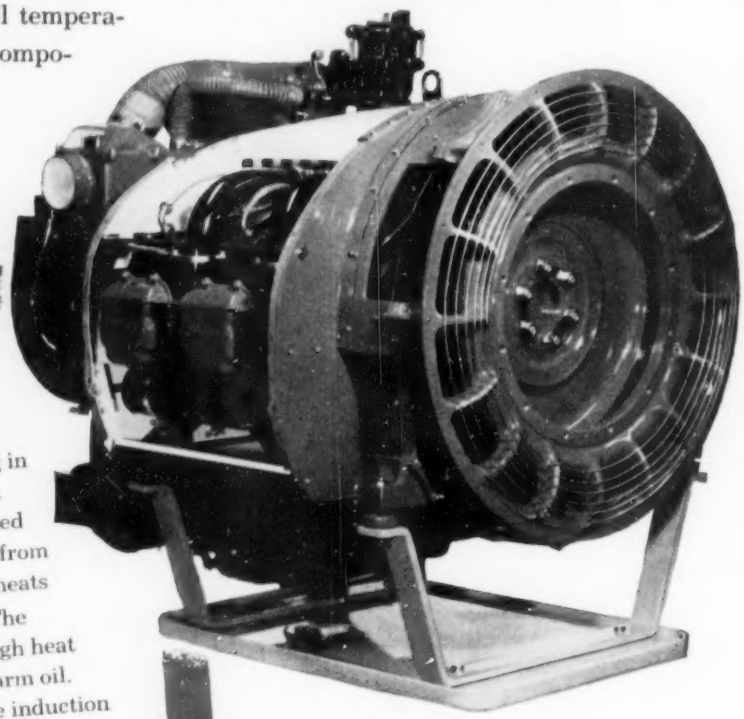
Meeting the stiffest requirements of cold-weather starting, the South Wind Heater can be used for pre-heating any engine in the Packette series. Makes starting easier, faster at all temperatures by flooding engine components, battery, crankcase and carburetor with warm heated air.



Duct carries hot air...

to crankcase through opening in block to heat inside of engine. Engine is completely shrouded to capture heat as it escapes from interior – this warm air pre-heats exterior surface of engine. The heater exhaust passes through heat exchanger in oil sump to warm oil. Hot air is diverted to engine induction system for starting phase.

There's a South Wind Heater for every Pre-Heating need

Do You Have A Heating Problem? South Wind is prepared to install pre-heating systems in every way to answer your requirements. Write today for the experienced counsel of South Wind field engineers about *any* problem in external or internal pre-heating. Wide range of South Wind Heaters includes 20,000–30,000–50,000–100,000–200,000 and 600,000 BTU/hr. capacities. Stewart-Warner Corporation, South Wind Division, Indianapolis, Ind.

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► **UAL Readies DC-3 For Radar Test**—United Air Lines has withdrawn a DC-3 from service to begin installation of the experimental weather warning radar under development by Radio Corporation of America. (Aviation Week Dec. 22, 1952, p. 11). One objective of UAL tests will be to evaluate storm penetration ability of proposed 5.7 cm (wavelength) radar. The DC-3 will use an 18-in. dia. antenna but results will be extrapolated to show performance possible with 30-in. dia. antenna which would be used if 5.7 cm. is adopted.

► **Collins Enters Microwave Field**—Newest entrant in the microwave network field is Collins Radio Co. which has a proposal under consideration by a major airline.

► **F3D Radar**—The Westinghouse APG-35 search and track radar which has enabled Marine-flown F3Ds to down several Red night fighters in Korea "stems from seven years experience with night fighter radar equipment by Westinghouse Electric Co.," a company spokesman says. The radar is manufactured at the Westinghouse Air-Arm Division in Baltimore.

► **Report on AA's Reservisor**—American Airlines automatic reservations computer, called the Reservisor, handled 4 million "calls" during its first seven months of operation, according to E. L. Schmidt of Teleregister Corp., which built the device. Schmidt told an AIEE audience at the recent national convention in New York that a total of 88 vacuum tubes had been replaced in the 1,500-tube Reservisor during the seven-month period, most of them prior to actual tube failure.

► **Cornell Evaluates Tube Failures**—Cornell Aeronautical Lab, under Signal Corps contract, is now analyzing vacuum tubes which experience a rejection rate of 2% or more at electronic equipment manufacturers' plants to determine cause of high rejection rate. If analysis shows tube is not at fault, Cornell will analyze equipment for possible misapplication of the tube.

► **Study Auto-Tube Production**—Signal Corps program is studying application of automatic production techniques to manufacture of vacuum tubes. Signal Corps spokesman thinks that automatic production techniques would improve tube reliability by eliminating variable factors due to human operators and by simplifying tube construction to permit automatic assembly.—**PK**

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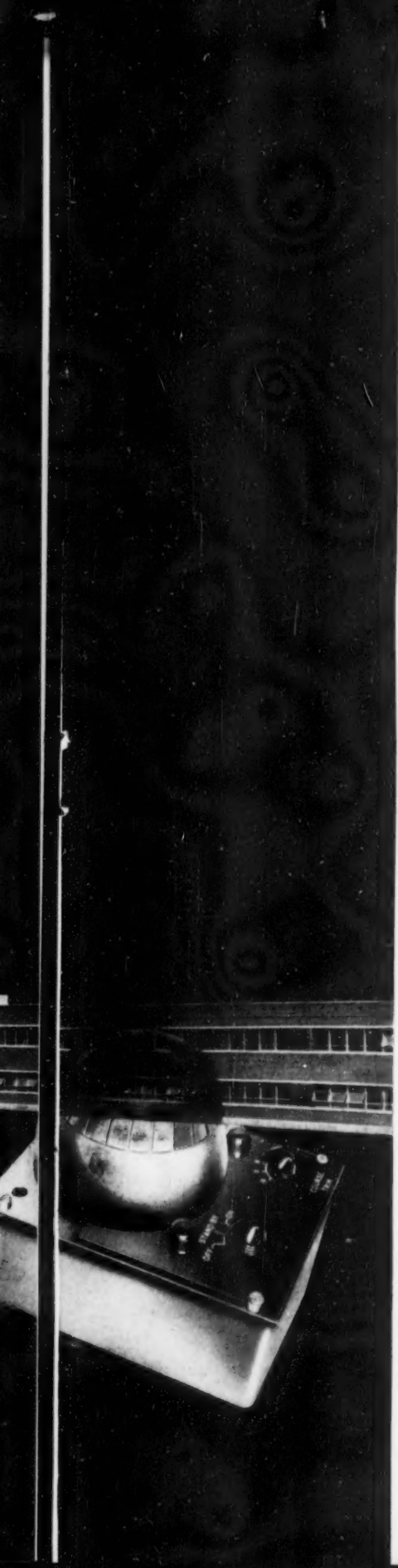
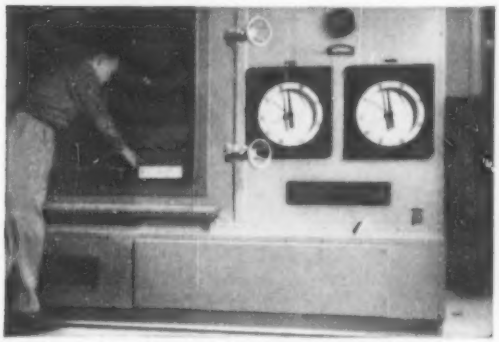
Advancing pushbutton aviation



An impressive concentration of top aviation engineers and electronic specialists was recently assigned to the new Westinghouse Air Arm Division in Baltimore. The huge plant, occupying 75 acres next to the Baltimore Friendship Airport, has space to integrate all Westinghouse air-borne electronic engineering, testing and production facilities into one operation . . . with the opportunity for both air-borne and environmental testing.

Already this division has designed, tested and put into production some outstanding developments. One is the Westinghouse Autopilot, the first automatic pilot to utilize three "non-tumbling" gyroscopes and to provide unlimited maneuverability. Also of great value to our nation's military needs are the tremendous advances made on complete fire-control systems and guided missile systems.

These rapid strides were possible because of unmatched resources, such as: a Flight Engineering Department with hangar and company-owned planes . . . an REAC Analog Computer with flight simulator equipment . . . environmental test facilities, such as the one illustrated below . . . and a large staff of trained service engineers. All these Westinghouse facilities under one roof for one purpose—*advancing tomorrow's pushbutton aviation.* Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-91004



This Atmospheric Chamber simulates conditions from −65° to +160° centigrade, altitudes up to 80,000 feet. It also varies humidity 20 to 95 per cent and automatically controls these variable conditions to any pre-set values.

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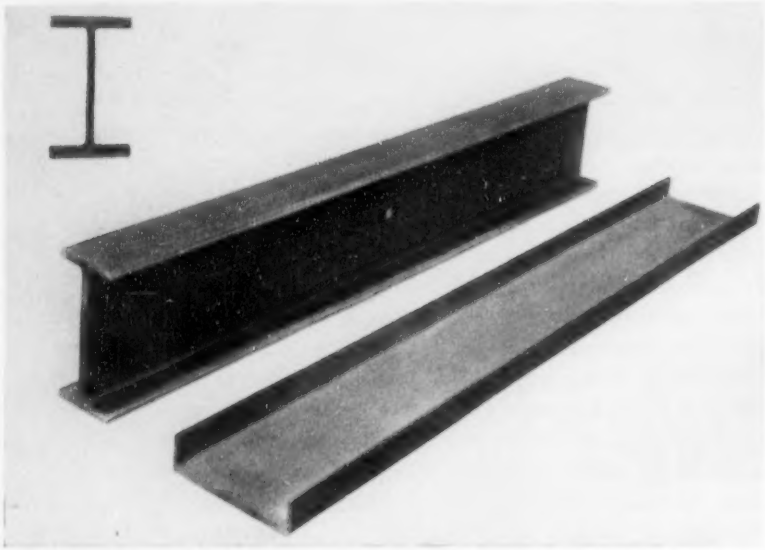


AIRCRAFT I-beam and channel are typical structures that can be made of plastics.

Designers Seek Plastics Knowhow

The materials are here; now we must learn how to take advantage of their properties, engineer says.

New reinforced plastic materials are ready for fabrication into complete airplanes, with large savings in production costs in prospect, a leading U. S. plastics industry engineer told AVIATION WEEK.

William E. Braham, chief engineer of Zenith Plastics Co., Gardena, Calif., forecast important savings in simplified tooling and in airframe weight, as well as advantages in heat-resistance for supersonic flight.

Cited particularly by Braham are three U. S.-developed glass fiber plastics: Bakelite's BV17085 and BV-11946, and Cincinnati Testing Laboratories' 9ILD. A fourth equivalent plastic is the British asbestos-fiber plastic bonded material, Durestos. All utilize phenolic resins as bonding agents.

▶ **Design Problems**—To utilize the new reinforced plastics in primary structures such as wings, fuselages, and tails economically and to take advantage of their different properties requires some new aircraft design techniques, Braham said.

Rapid tempo of development and improvement in reinforced plastics and lack of coordinated information on material properties and production and tooling knowhow are responsible for the fact that there are few U. S. designers acquainted with these techniques.

▶ **Radar Transparency**—Military planes built from electronically transparent plastics would have considerable advantage over metal aircraft in evading detection by enemy radar networks, Braham pointed out.

Here are some large aircraft plastic parts already made by Zenith on relatively low-cost tooling, according to Braham:

- **Aircraft fuselage section** about 18 ft. long, 6 ft. high and 3½ ft. wide for use on a Lockheed military plane.
- **Radar housing** 30 ft. by 20 ft. by 6 ft. for use on a Lockheed WV-2 early-warning Super Constellation.
- **Highly-stressed tail surfaces** and wing sections for large jet aircraft.

Zenith is making design studies on complete wings and fuselages for high-performance jet planes.

Other Zenith aircraft plastic products include commercial window frames for Convair 340s and DC6-B transports some air intake ducts for jet engines, radomes for other planes, and wingtip and fintip coverings for flush antennas, carrying loads greater in some cases than are carried by structural parts of some small fighter planes, Braham said.

The Zenith chief engineer, formerly an aircraft engineer at Glenn L. Martin Co. and Lockheed, said his company is making an estimated 80% of the reinforced plastic parts on military aircraft in the U. S. under subcontracts to many of the principal aircraft companies.

▶ **Heat-Resistant** — Temperature-resistant qualities of the new plastics begin to pay-off in operating temperatures hotter than 300F, such as are encountered at speeds of around 1,300 mph. At twice this speed, the temperature would be higher than 1,000F. German scientists reported records of 1,500F on the surface of the V-2 rocket in flight tests, Braham said.

Mechanical properties of aircraft aluminum alloys drop rapidly in temperatures hotter than 300F, Braham said, but the new reinforced plastics have indicated tensile and compressive strengths of at least 40,000 lb. per sq. in. with little or no appreciable change in properties at temperatures up to 500F.

A still newer resin in early development stage is expected to result in material with equally good properties up to 600F, the Zenith spokesman reported.

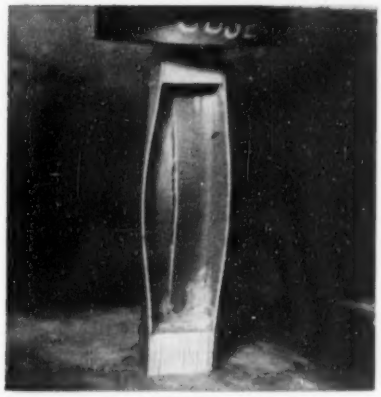
▶ **Plastic Properties**—Although in some cases reinforced plastics indicate no weight-saving over comparable metal structures, there are many where the plastics would be lighter.

Some metal parts of existing aircraft and missiles are not heavily loaded, but their weights are governed by manufacturing techniques and surface smoothness requirements. Often reinforced plastics can be used to produce smoother surfaces and sections thick enough to satisfy requirements and with appreciable weight-savings. Braham said glass fibers impregnated with plastic resins weigh approximately 65% as much as aluminum alloys of the same volume and about 25% as much as steel alloys.

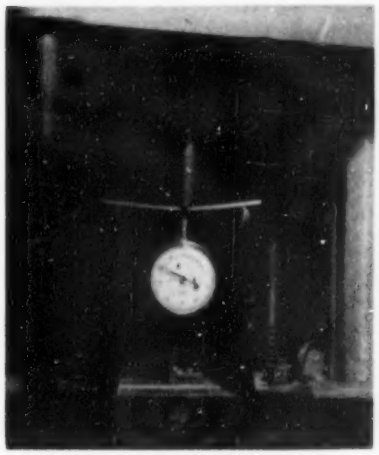
Ratio of the modulus of elasticity to density for some of the new glass plastics is indicated as almost equivalent to that for aluminum alloys used in aircraft structure. But ratio of sheer modulus to density for the plastic materials is not as high as aluminum alloys, so it would be necessary to use thicker plastic sections to attain the same stiffness in shear. However, Braham said it is relatively easy to eliminate by design changes buckling caused by shear forces in structural panels made of plastics, while relatively heavy stiffening members are needed to eliminate buckling of sheet metal panels.

It is not yet possible to make a general rule to determine whether a plastic structure can be made as stiff as a metal one of the same weight, Braham said.

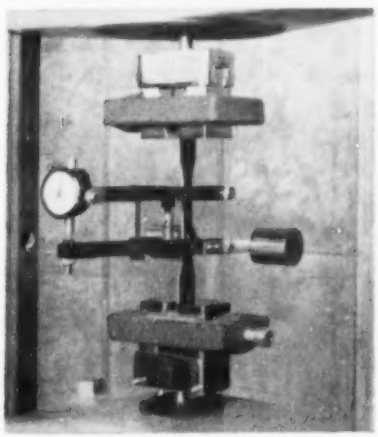
▶ **Tapered Plastics**—Modern aircraft



In compression: Better than aluminum.



In bending: As good as light metals.



In tension: Better than metal alloys.

requirements for tapered metal plates is being met at great expense by complicated machining processes, Braham pointed out, and it is felt that comparable tapered plastic assemblies can be produced with semi-skilled labor and with no expensive equipment other than molds for forming the structures. The molds usually are less costly than equivalent tooling to form similar metal structures, and less floor

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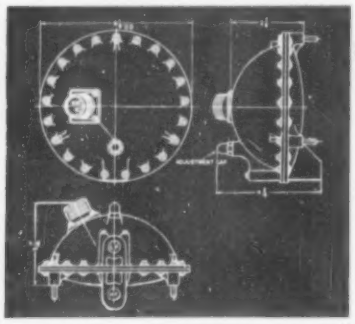

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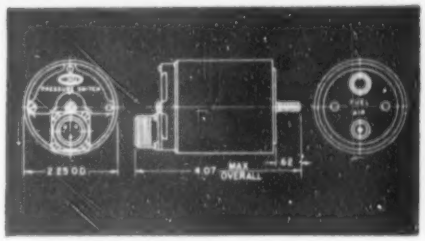

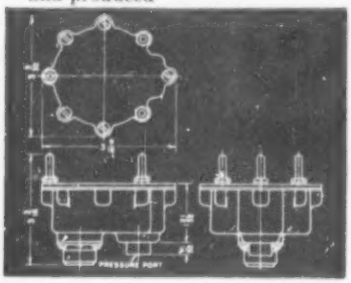

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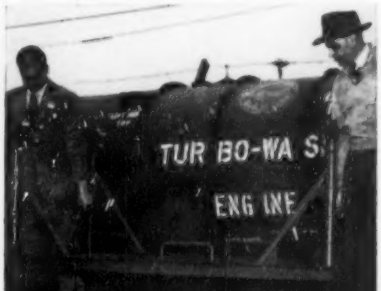
space and fewer complex assembly fixtures are required, Braham said.

The ease with which plastic components can be bonded together and the many structural details that can be molded into them during fabrication are production advantages. Limitation of stock widths, thicknesses and lengths of metal materials—which make numerous splices and joints necessary in metal assemblies—makes plastic assembly methods even more attractive in contrast, Braham said.

► **British Progress**—Braham said British aircraft development progress, using Durestos material, is well ahead of comparable programs in this country. However, he did not consider Durestos a better or more suitable material than American glass fiber-plastic impregnated materials. Britain used asbestos fibers because of its abundance.

Fibrous glass material is available in large quantities in this country, and there is more than enough glass fibers and phenolics to rebuild the present U. S. military and civil air fleet from these materials if it is desired, Braham said.

The engineer reported that during a recent visit to England he saw a Durestos delta wing under construction for a Fairey E.10/47 research plane and saw other completed "articles." Some British manufacturers are actively engaged in design and production of complete guided missile airframes equivalent in size to some of our smaller fighter planes. Braham predicted Durestos would appear in increasing quantity in wings and fuselages of British aircraft and guided missiles in the near future.—AMcS



EIGHT AT ONCE

Eight Pratt & Whitney Aircraft J57 jet engines can be airshipped in a C-97 to Boeing Airplane Co.'s B-52 Stratofortress production lines in Seattle, by means of new shipping stands. Made of steel tubing and 2-in. I-beams, the stands weigh 230 lb. each. Previously, engines were shipped in 3,300-lb. cans (background), and only four could be accommodated in the C-97. The new stands were designed by Boeing engineers and USAF test pilot stationed at the company.

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- **Bendix Aviation Corp.**, Sidney, N. Y., aircraft parts, $141,851, 65%.
- **Underwood Corp.**, New York, aircraft instruments, $217,347, 65%.
- **Bendix Aviation Corp.**, Teterboro, N. J., aircraft instruments, $67,643, 60%; $135,-904, 50%.
- **Viking Tool & Machine Corp.**, Belleville, N. J., aircraft parts, $30,189, 70%.
- **Ronson Art Metal Works, Inc.**, Newark, N. J., aircraft parts, $21,319, 65%.
- **Aviation Engineering Corp.**, Woodside, L. I., N. Y., aircraft parts, $21,876, 70%.
- **American Non-Gran Bronze Co.**, Berwyn, Pa., aircraft parts, $27,035, 70%.
- **Ex-Cell-O Corp.**, Highland Park, Mich., aircraft parts, $254,265, 65%.
- **Typo Machine Co.**, Cleveland, aircraft parts, $5,958, 70%.
- **Holley Carburetor Co.**, Detroit, aircraft parts, $3,831, 65%.
- **Aeroguild Inc.**, Roseville, Mich., aircraft parts, $6,878, 70%.
- **Goodyear Aircraft Corp.**, Akron, aircraft parts, $110,505, 65%.
- **Beech Aircraft Corp.**, Wichita, aircraft, $154,077, 60%.
- **Jonco Aircraft Corp.**, Shawnee, Okla., aircraft parts, $312,000, 70%.
- **Douglas Aircraft Co., Inc.**, Santa Monica, Calif., aircraft and parts, $230,187, 65%.
- **Magna Mill Products**, South Gate, Calif., aircraft & ordnance parts, $7,441, 70%.
- **Aerojet Engineering Corp.**, Azusa, Calif., ordnance, $23,394, 65%.
- **Hiller Helicopters**, San Mateo County, Calif., aircraft & aircraft products, $90,617, 40%.
- **United Aircraft Corp.**, East Hartford, Conn., aircraft engines and parts, $5,247,-000, 65%.
- **Plane Parts, Inc.** New Haven, Conn., aircraft parts, $24,390, 70%.
- **Swann Tool & Machine Co.**, Hartford, Conn., machine tools and aircraft parts, $11,157, 70%.
- **Seaboard & Western Airlines, Inc.**, New York, air transportation, $9,500,000, 80%.
- **B. G. Instrument Corp.**, Corona, N. Y., aircraft parts, $4,524, 70%.
- **Schafer & Kordal Assoc.**, Mineola, L. I., N. Y., electronic and aircraft parts, $3,249, 70%.
- **Man-Sew Corp.**, New York, N. Y., aircraft parts, $11,243, 70%.
- **Charles Engelhard, Inc.**, East Newark, N. J., aircraft parts, $52,527, 70%.
- **General Motors Corp.**, Indianapolis, development and testing of aircraft engines, $1,936,500, 60%.
- **Continental Air Lines, Inc.**, Denver, air transportation, $5,067,711, 80%.
- **Tapered Air Products**, Los Angeles, Calif., aircraft parts, $42,000, 70%.
- **Lockheed Aircraft Corp.**, Burbank, Calif., aircraft & aircraft parts, $74,863, 60%.
- **Starr Engineering Co.**, North Hollywood, Calif., aircraft parts, $107,306, 70%.
- **Alloy Spot Welders**, Los Angeles, machining of aircraft and electronic parts, $30,248, 70%.
- **Martin Aircraft Tool Co.**, South Gate, Calif., aircraft tools, $1,726, 70%.
- **G & M Machine Co., Inc.**, Los Angeles, aircraft tools and aircraft parts, $88,304, 70%.
- **Narmco Manufacturing Co.**, La Mesa, Calif., aircraft parts, $35,500, 45%.
- **Lockheed Aircraft Corp.**, Burbank, Calif., aircraft parts, $37,098, 60%.
- **Hewitt and Faust Manufacturing Co.**, El Cajon, Calif., aircraft tools, jigs and fixtures, $77,075, 45%.
- **Weba, Inc., New York**, aircraft parts, $14,346, 70%.
- **Magnus Tool & Die Co.**, Newark, N. J., aircraft parts, $3,643, 70%.

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Single copies will still be sent for reference purposes to agencies and offices which have received the synopsis in the past. But distribution on a pick-up basis to interested individuals will be discontinued.

The subscription price is $7.00 a year, or $4.00 for six months. Check or money order, payable to the Treasurer of the United States, should be sent to U. S. Dept. of Commerce, Administrative Service Office, Room 1300, New P. O. Bldg., 433 W. Van Buren St., Chicago 7, Ill.

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EQUIPMENT

Liquid Spring Offers Strut Gains

CPT pushes compressed-oil shock-absorbing gear; Company sees big future for linear actuators.

By George L. Christian

Cleveland—Cleveland Pneumatic Tool Co., now completely owned by its employes, is projecting a three-pronged development and production drive. Involved in the triple drive are:

- **New liquid-spring landing gear.**
- **Aerol (air-oil) shock struts.**
- **Aircraft linear actuators.**

The company also is actively engaged in research aimed at saving critical materials and reducing machining costs to a minimum.

▶ **Liquid Spring**—Although Cleveland Pneumatic has been making the Aerol combination air-oil shock strut for some time, and the equipment has proved to be rugged and trouble-free, company engineers saw considerable advantages in the use of all-liquid springs, including increased capacity, smaller size, lighter weight.

As far back as 1946 and 1947, company tests showed that compressed oil could give effective springing and damping. Standard AN-O-366 oil compresses about 8% when pressure is increased from 0 to 25,000 psi. Application of the principle was blocked by the fact that conventional sealing glands would not stand up under the high fluid pressures required.

▶ **Dowty Design**—The same problem had been faced by Dowty Equipment, Ltd., Cheltenham, England, and licked with a mechanical seal that can take operating pressures as high as 60,000 psi. The resulting liquid spring shock struts have been used on a number of British and Canadian aircraft, including the English Electric Canberra, the Bristol Brabazon, several Hawker jet fighters, the Avro Canada CF-100 fighter and C-102 Jetliner. The Fokker S.13 fourplacer also uses the liquid spring.

Success of the Dowty liquid-spring shock struts led Cleveland Pneumatic to obtain exclusive American rights for the manufacture and sale of the equipment in 1949. Use of the Cleveland Pneumatic unit is being planned in several new high-performance jet aircraft now on the drawing board.

But, CPT spokesmen point out, this type of landing gear "offers greatest advantages only when installed in aircraft designed for its use. It is obviously not a cure-all. Many types of aircraft will continue to be served better by Aerol struts of the presently familiar type."

First U. S. applications of liquid spring struts will be in near-sonic and supersonic fighters where gear stowage space is at a premium, CPT expects.

▶ **Many Advantages**—Here are some of the features that R. C. Gazley, the company's assistant chief engineer, sees recommending the new-type struts:

- **Increased capacity.** Liquid-spring struts can be designed for static pressures of 20,000 to 25,000 psi., whereas Aerol struts are designed for the 1,000-1,500-psi. range, partly because of the explosive nature of air compressed much beyond these limits. A 1,000-psi. Aerol strut has an extended pressure of 250 psi. and a fully compressed pressure of 3,000 psi.
- **Smaller, lighter.** The internal pressure means this in terms of size:

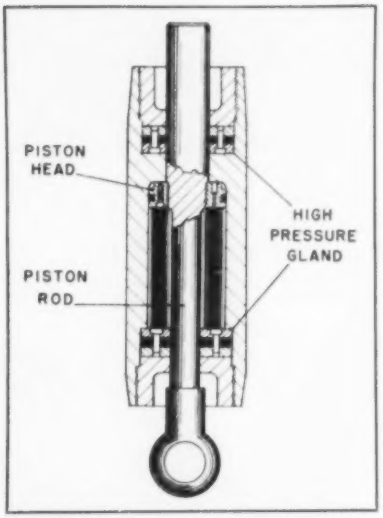
The static load on each main gear of a hypothetical 150,000-lb. aircraft would be 63,000 lb. The piston for an Aerol unit for this plane would be 9 inches in diameter and would be housed in a cylinder with 10¾-in. outside diameter. A liquid spring at 20,000 psi. would support this 63,000-lb. load with a piston only two inches in diameter.

Cleveland engineers are happy about the design flexibility this choice of two different types of gear gives them.

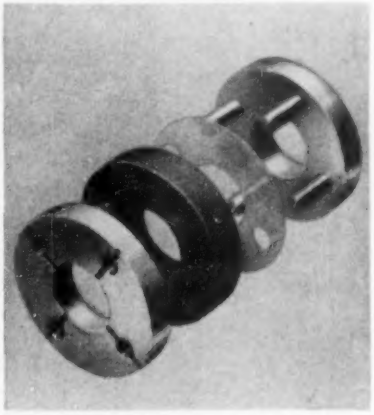
▶ **Articulated Gear**—Liquid-spring shock absorbing units are often used in conjunction with levered suspension, or articulated, landing gear configurations. Such installations are used much more extensively abroad than in the U. S.

Cleveland Pneumatic finds that articulated liquid-spring landing gears offer several advantages:

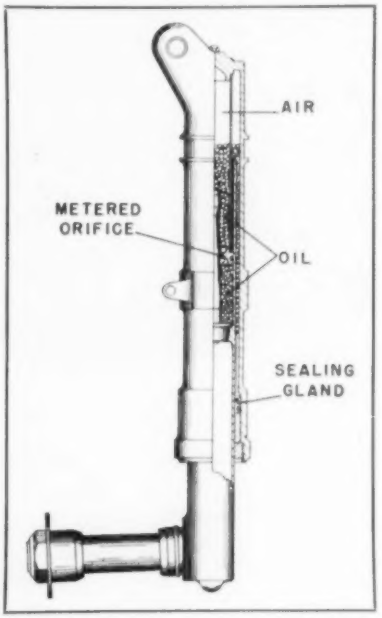
- **Compact.** The gear may be unusually short and compact because of the relatively short shock absorber stroke required for a given distance of wheel travel. Result is that the gear takes a minimum retracted stowage space.
- **Independent unit.** Liquid-spring component of the articulated gear may be a completely independent unit, so can be designed for maximum shock absorber efficiency. Structural considerations are taken care of in the articulated gear assembly proper, and the spring can be serviced as an independent unit.
- **Structural efficiency.** Since support



LIQUID-SPRING struts, depending on . . .



HIGH-PRESSURE sealing glands, replace . .



AEROL shock gear in some applications.

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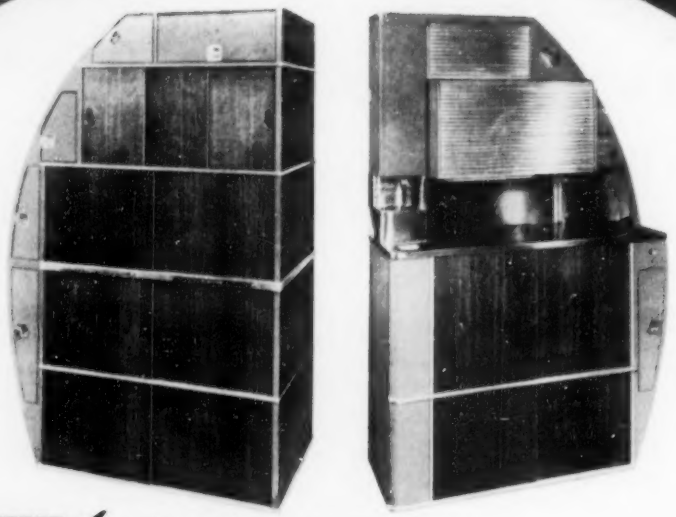

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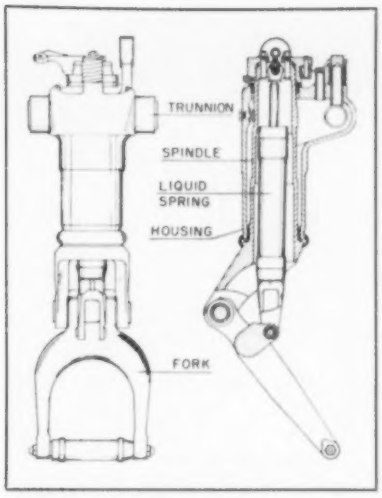

ARTICULATED GEAR is lighter, stronger.

the gear components proper, they can be designed for maximum structural efficiency.

• **Clear contour.** Geometry of the articulated gear allows all shimmy damping, centering and steering mechanisms to be located in the upper section of the gear. Result is that the portion of the strut protruding into the airstream can be of unusually clean contour to reduce drag.

• **Softer shock.** Fact that the wheel moves backward (as well as upward) upon initial contact with the ground cuts sudden spin-up shock loads on tires and wheels. These loads are becoming increasingly severe as aircraft weights and landing speeds increase.

▶ **Cantilever Gear**—Cantilever-type main landing gear starts taking the play away from the articulated variety as gear length increases, Cleveland Pneumatic points out. Variations in main gear landing attitude sometimes make the use of articulated gear impractical. However, this type of strut configuration is used on the main legs of the Fokker S.13 four-seater plane.

Most liquid-spring main legs are of the cantilever type. Although resembling, at casual glance, a standard Aerol gear, there are basic differences:

• Outer liquid-spring cylinder of the cantilever type carries no internal pressure. Therefore, it may be designed exclusively for optimum structural efficiency. Aluminum alloy such as 75ST is normally used.

• The piston rod, usually the moving part in an Aerol gear, is fixed to the top of the outer housing in the liquid-spring type to keep the piston head stationary. Head contains damping ports. The moving part is the cylinder which slides between the outer housing and the piston head and rod. Example of static pressure contained within the cylinder is 15,900 psi. for the Brabazon

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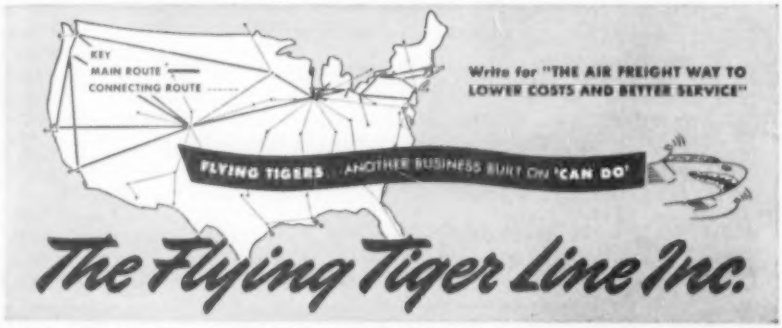
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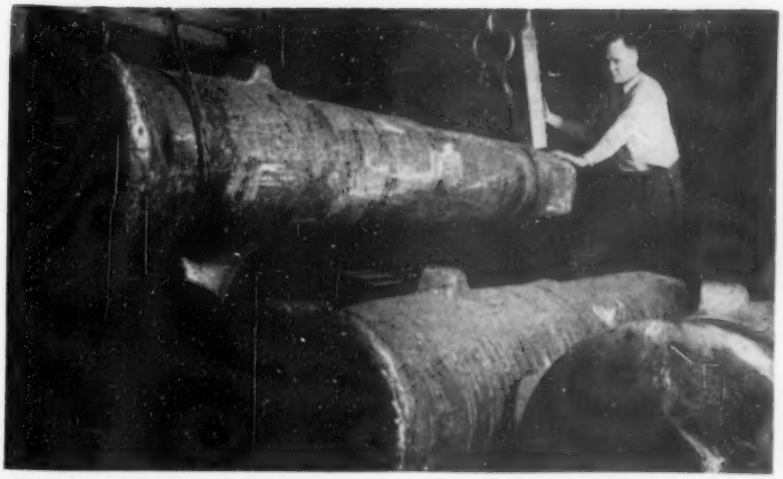
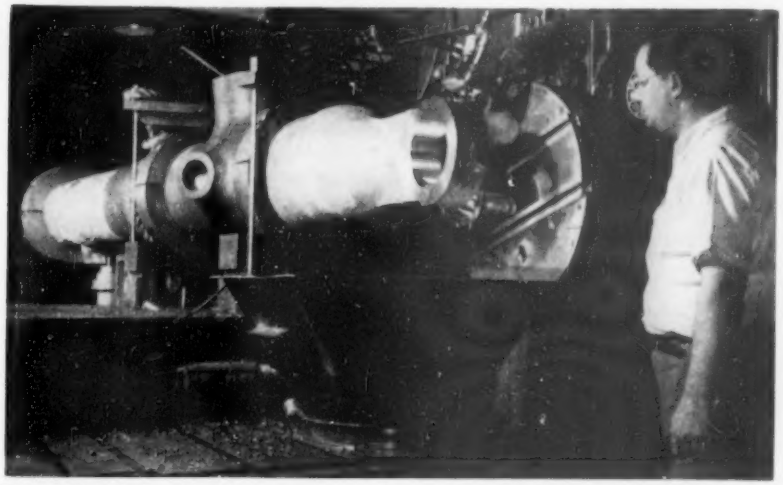


HUGE FORGINGS for B-36 landing gear columns are supplied by Ladish Co., Milwaukee.



MACHINING by CPT brings rough weight of 8,400 lb. down to 1,200 lb. finished.

main gear which supports a static load of 134,060 lb.

▶ **Slimmer Strut**—Still using the Brabazon gear to illustrate a point, Cleveland Pneumatic says that the strut has a 10.5-in. outside diameter. Strut could be made smaller by raising pressure of liquid, or it could be made larger if structural efficiency so dictated. Smallest diameter for a comparable Aerol gear would be 13.6 in. The only change possible in the conventional gear would be to enlarge it. This is an example of flexibility offered by the liquid-spring principle.

The slimmer struts allow wheels to be closer to the gear's centerline, and lead to these advantages:

• **Less strain.** In either one- or two-wheel designs, this means lower bending and torsional moments for normal landing loads. In a two-wheel gear, (one wheel on each side of the main strut) this advantage also applies to asymmetrical landing loads.

• **Lighter structure.** Lower asymmetrical reactions at trunnion points lead to lighter airframe structure.

• **Smaller wheel wells** can lead to lighter well frames, smaller and lighter wheel-well doors and door-operating mechanisms, and more room for other services. And, for gear retracting into the wing proper, thinner wings may be designed.

▶ **Efficiency**—Load-stroke curves of oil with a plain orifice show efficiency of about 75%. Contrary to the sudden rise of adiabatic (no heat added or taken away) air compression curves on the compression end of the chart, oil compression curves are very nearly linear.

Comparable air-oil efficiency with a plain orifice is closer to 65%.

▶ **Maintenance**—Filling 10,000-20,000-psi. struts poses a vastly different problem from that of pumping up a 1,000-psi. Aerol. Grease guns can handle pressures up to 5,000 psi. and special equipment can easily be designed to handle higher pressures, according to Cleveland Pneumatic.

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the liquid-spring seal is maintenance-free, requiring very occasional servicing at major overhauls only, the firm adds.

Laboratory tests indicate that liquid-spring seals work well at low temperatures. They are said to be comparable to standard "O" rings which seal well at −65F and do not leak statically down to −100F.

The company does not anticipate any problems from the fact that liquid-spring oil volume decreases with cold, since the same thing happens to the air and oil in Aerol struts without giving any trouble.

▶ **Strut Developments**—Cleveland Pneumatic has been designing and manufacturing Aerol struts since 1926.

Once they met the basic needs of shock absorption and support, CPT engineers devoted their attention to weight and size reduction. This led to the consideration of aluminum for the struts.

Originally, steel was the basic ingredient—usually SAE 4340 nickel-chromium-molybdenum steel, heat-treated to 200,000 psi.

As new, stronger aluminum alloys came into existence—14ST and 75ST for instance—aluminum gave a better strength/weight ratio than 4340 steel. These aluminums have a stress range of 60,000–72,000 psi. and weigh approximately one-third as much as steel. Therefore any aluminum whose stress limits exceed 1/3 of 200,000 psi. has a favorable strength/weight ratio over steel.

Cleveland Pneumatic made, and still makes, aluminum landing gear for certain applications. But after CPT technicians began investigating 4340 steel in the 260,000–280,000-psi. stress range, steel again offered the better strength/weight ratio.

▶ **Steel Advantages**—Significant advantages of fabricating landing gears from the more highly stressed steel are:

• **Weight-saving.** Assistant Chief Engineer Gazley cites a typical large, four-engine aircraft: main legs weighing 1,040 lb. and a 470-lb. nose strut bring total gear weight to 1,510 lb. Using high-stress 4340 steel at least 15% weight is saved—in this case, 226.5 lb.—equal to one passenger and all his baggage, with weight to spare.

• **Higher takeoff gross.** Aircraft gross takeoff weights may be substantially increased without upping landing gear weight, as a result of this steel's greater strength.

▶ **Disadvantages**—These advantages are not achieved without paying certain penalties, Gazley remarks.

• **Toughness.** The stronger material is extremely difficult to machine, is almost as hard as the cutting tools used on it. A considerable amount of work was needed before the proper carbide tools and proper machining feeds and speeds were determined. CPT now has the large, rugged machine tools required to work on very-high-strength steels in the the sizes used for major landing gear components.

• **High cost.** The finished product costs more than struts made from 200,000-psi. steel or aluminum because of higher machining and tool costs. But Cleveland Pneumatic predicts that costs will drop with continued refinement of machining techniques and increased volume of production.

▶ **Linear Actuators**—Cleveland Pneumatic has long been making ball bearing screw assemblies for actuators. Recently it decided to go into the design and development of the entire actuator. First step was to acquire exclusive license to patent rights of an efficient ball bearing screw, in this case, the Hoffar patents.

Linear actuators are fussy mechanisms compared to rugged landing gear assemblies, Gazley told AVIATION WEEK, but CPT solved the problems involved. Cleveland units are on several production aircraft and at least one experimental plane.

Some applications are rudder trim on North American F-86 Sabres, horizontal stabilizer control on a Grumman plane, rotor pitch control on Piasecki HUP helicopters, and the wing-sweep

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and wing-movement actuators on Bell's variable-sweep X-5 experimental jet job. The company also makes the complete flap-actuating system for the Beech T-36A, landing-gear-retraction mechanism for the ZP2N blimp built for the Navy by Goodyear, and the major components and ball-screws for a radome actuating system.

CPT says it supplies a big majority of Boeing actuating screw requirements, having units on the 377, B-50, C-97, B-47 and B-52. The actuator division has an order for a complete set of actuators for one transonic windtunnel and a set of ball screws for another supersonic tunnel.

CPT engineers say they are in a position to design electro-mechanical, hydraulic or pneumatic actuators and complete actuating systems.

▶**Production Studies**—Cleveland Pneumatic, because of the nature of its work, involving considerable machining of steel and aluminum, has done much to save materials and machining costs, officials say.

Part of its efforts impinge on the USAF heavy press program, because of the size of the forgings used for large landing gears manufactured by CPT.

USAF's heavy press program was designed primarily to produce flat forgings, say Cleveland Pneumatic spokesmen. Because of CPT's requirements, some of the new presses will have additional side cylinders which will allow the machines' vertical rams to hold forging in a split die while side cylinders extrude forging barrels over the rams.

The ability to produce tubular, hollow forgings in sizes now unproduceable will save important quantities of raw materials and allow a significant reduction in machining time and cutting tool consumption. CPT-designed hollow forgings already placed in production are saving about one million pounds of critical raw material over similar, solid forgings, according to the company. When the new, heavy presses come into use, permitting forging of still larger pieces, these savings will increase rapidly.

New forging techniques will have to be developed to implement the new, large hollow forging methods.

▶**Into the Future**—Brightest spot in Cleveland Pneumatic's future, say company executives, is "the almost certain rapid expansion of ball-screw actuators to all kinds of uses . . . because of the extremely high efficiency of this kind of actuator . . . requiring a relatively small amount of power to move a given load."

The design and construction of shock struts for the highspeed, hydro-ski-equipped seaplane also provides interesting future prospects to CPT. Problems involved in designing hydro-ski shock struts would be essentially the

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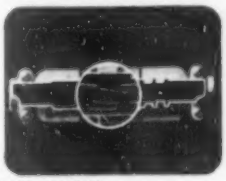
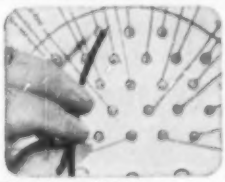


CURRENT CAPACITY
and its relation to contact spacing.



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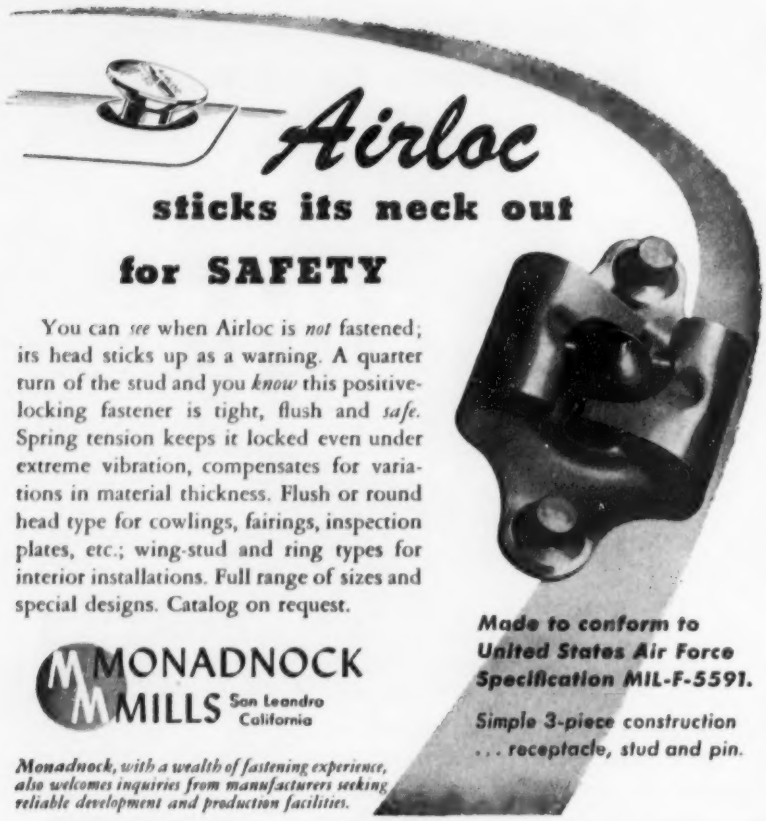

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same as those surrounding landplane gear—they have to be able to absorb impact loads and must be retractable. Corrosion problems because of salt water will have to be solved, however.

Cleveland Pneumatic Tool Co. was founded in 1894. The original factory had a total area of 600 sq. ft. Today the company's office and shops sprawl over almost 562,000 sq. ft. occupying some 18 areas of land and employing over 2,700 personnel.

Lear Distributors Get New Sales Plan

Lear-Cal Division of Lear, Inc., has set up a new aviation sales program whereby company salesmen help dealers and distributors get into the firm's Hundred Grand Club.

The program gets its name from the sales target figure of $100,000 for Lear equipment such as autopilots, aircraft radios, navigation aids, etc.

Salesmen help dealers and distributors set up merchandising programs ranging from flight demonstrations to advertising campaigns.

BELLY-MOUNT CAMERA

To photograph takeoff and landing shots of its DC-6Bs for an educational movie it is making, American Airlines rigged a camera under the aft section of one of its planes. Easily detachable tubular mount supports the camera which is protected by a sheet metal housing. Camera opens from the rear to allow changing film and focusing of lens. Power lead goes through fuselage skin to lounge where the cameraman sits. AA's chief test pilot, Capt. Phil Beckman, had a ticklish job landing the big ship. The mount had only a 31-in. clearance with the ground. The nose wheel extends 14 in. below its normal ground position to allow for shock absorption, leaving Capt. Beckman less than a foot to play with when landing, as he had to, on his main gear first. He did not scratch the mount once.

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One company that finds Inconel the answer to many of their high temperature problems is The Surface Combustion Corporation.

They wanted to make their Janitrol aircraft heater lighter and at the same time deliver more heat. The heart of these heaters was a smooth metal cylinder which served as a combustion tube within a corrugated combustion chamber. The Janitrol "Whirling Flame" burns inside, heating the metal to incandescence.

For greater B.T.U. output they needed a metal that would stand up under the extra heat. So they began the search for a metal that could take it. After many gruelling-flame-endurance tests they finally came to Inconel — and it outlasted all other metals tried.

Moreover, units fabricated from Inconel were 10% lighter and gave more rapid heat transfer. Plus the fact that they were stronger and easier to fabricate.

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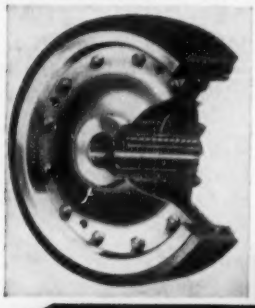

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NEW AVIATION PRODUCTS

Navy Studies Anti-Corrosion Gels

Costly damage to stored aircraft engines has often been traced to failure of standard preservatives to prevent corrosion. This has led to a new specification, MIL-C-5545, and work on new compounds that it is hoped will solve the problem.

"Thixotropy" is the key to the solution. The word means "change by touch." New anti-corrosion compounds under study are thixotropic.

Fortunately, a compound which appeared to possess the desired properties was presented to the Navy at about the time the need for it was realized, relates Joseph Carroll of the Naval Aviation Experimental Station in Philadelphia. Later tests, described by Carroll before the Joint Industry Conference on Preservation and Packaging held recently in Camden, N. J., confirmed the belief the compound met these requirements.

Navy's job then became one of developing means of controlling the formulation to assure uniform performance.

▶ **Sticks to Job**—One formulation the Navy tried, mixed 50-50 with 1100 oil, turns into a hard gel inside the engine, yet breaks down when shaken or stirred, so that it reconverts to a liquid on engine operation.

Tests by Navy show it does not drain off, as have its forerunners, under the action of tropical heat or after extended storage, leaving surfaces unprotected.

For depreservation, the engine is turned manually, causing the compound to revert to liquid form, and it is drained through depreservation valves on the lower cylinders of the engine. To get the remainder, the engine is flushed with lubricating oil and the compound burned in the combustion section.

Now used as a heavy engine preservative for long storage, the compound breaks down so well that it may possibly be developed into a standard all-purpose preservative, providing better protection and simplifying inventory by replacing fly-away, light preservatives now used for miscellaneous short-term protection.

▶ **Compound Specs**—One of the problems met in drawing up specifications was that the compound had to set sufficiently to prevent drain off, but not to the extent that it would clog passages and prevent effective circulation of oil at engine starting.

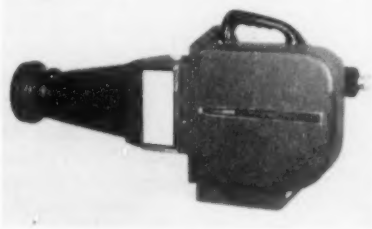
The new gel is thixotropic only in some respects. A broken thixotropic structure will rebuild itself in the course of time and the reaction takes place without heat. But the new compound must be applied hot to obtain the gel structure and it will not revert to a solid once broken down.

▶ **Navy Tests**—Navy tests to determine capability of the compound to prevent corrosion at high temperatures or under extended storage consisted of applying it at 200F to 1020 stainless steel panels having a finish similar to an engine cylinder surface.

The coated panels were cooled for 4 hr. at 77F, subjected to drain-off temperature of 140F for 20 hr., then exposed in a humidity cabinet operated at 120F under saturated conditions. The compound protected the panels for 60 days.

Navy is seeking means of improving the tests in the specification, so they more nearly simulate actual field conditions.

The compound presently is suitable for limited fly-away application and a 5-hr. engine endurance test is included in the specification. A number of utility trainers have used the compound experimentally as a lubricant in flight.



Highspeed Camera

A new camera capable of producing highspeed photos in large negative sizes may prove useful for recording the flight of high-altitude missiles and pilotless aircraft and photographing windtunnel data.

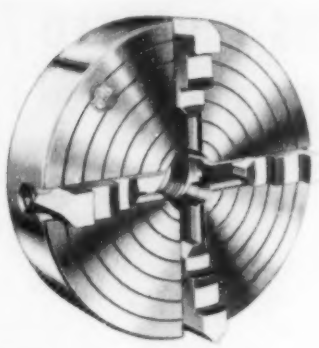
Utilizing a new design, the Hulcher 70 takes twenty-five 5-in. or fifty 2¼-in. pictures on 70-mm. film at speeds faster than 1/1,200th of a second. A double-rotating, disk-type focal-plane shutter is used.

The camera has no reciprocating parts, every moving mechanism revolving. The aim of the manufacturer was to eliminate conventional camera difficulties such as shutter and film-transport complexity.

The 32-lb. apparatus is sold without lens, but users have installed lenses ranging from 7 to 40 inches. The lens plate

supplied with the camera can be used with an Eastman Kodak Aero Ektar f/2.5 with a 7-in. focal length. Focusing is done on a full-size screen through a reflex-type viewfinder.

Charles A. Hulcher Co., Inc., 40 Manteo Ave., Hampton, Va.



Chuck Ends Chatter

Chatter caused by excessive overhang is minimized with a new lathe chuck, designed so it can be mounted up close to the spindle bearing. This also eliminates need of an adapter, the maker says.

The chuck, made by Westcott Chuck Co., is a four-jaw unit for direct mounting on lathes, milling machines, grinders and other machine tools with 2¼-in. 8 thread spindles. Overhang of the part is about ½ in. less than conventional chucks, according to the firm.

Westcott Chuck Co., Oneida, N. Y.

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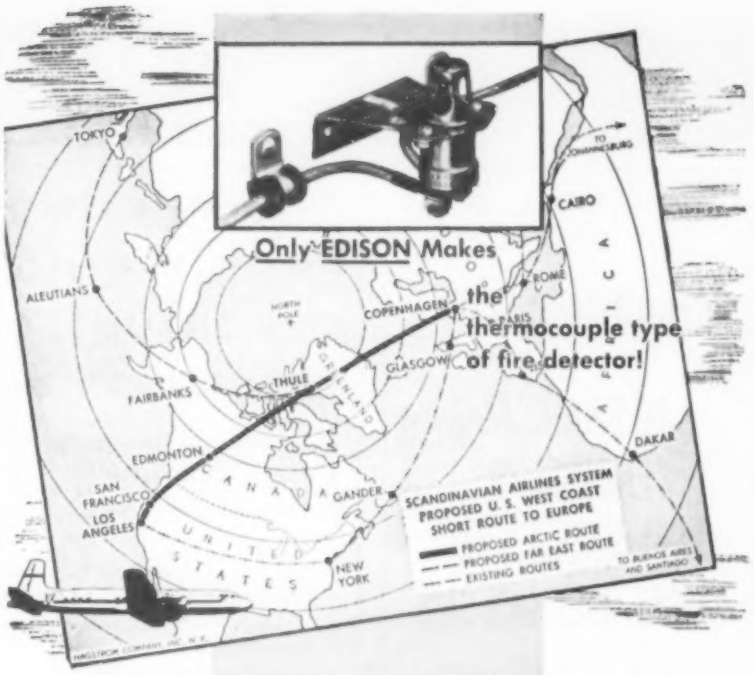
Ultrasonic degreasing cleans parts in new Circosonic machine. GE ultrasonic generator converts high-frequency electrical energy into mechanical action which is transmitted to cleaning solution, accelerating normal degreasing action—Topper Equipment Co., Clark Township, N. J.

Bushing driver developed for aircraft applications drives threaded inserts, automatically positioning them to the proper depth below face of casting and installing pressure plate to prevent inserts from backing out—Titan Tool Co., Main St., Fairview, Pa.



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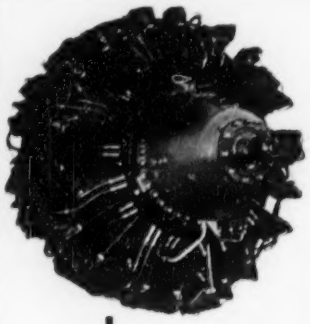

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10	15401-1	Eclipse	Amplifier (PB10) w/ED3 MOUNT
66	10078-1AG	Eclipse	Gyro Indicator
62	CQ-9	Eclipse	Clutch Switch (PB10)
11	12086-1C	Eclipse	Amplifier
19	15100-1B-A1	Eclipse	Pitch Trim Gauge
8	20000-43A-13A1	Eclipse	Magnesyn Indicator
67	23000-2A	Eclipse	Magnesyn Indicator
15	22101-11-A4	Eclipse	Pressure Trans.
6	2226-11C-3A	Eclipse	Dual Tach.
9	20100-42B-14A2	Eclipse	Torque Ind.
9	20000-8A-14	Eclipse	Magnesyn Pos. Ind.
23	20100-11C-4-A1	Eclipse	Wing Flap Indicator
11	DW-33	Eclipse	Transformer
23	CQ-2	Eclipse	Switch Box
75	1195-4-A	Eclipse	Vibrator
80	DW-28	Eclipse	Transformer
11	2227-11-D3A	Eclipse	Tachometer
75	1416-12E	Eclipse	Starter
100	716-3A	Eclipse	Generator (NEA-3A)
384	564-2A	Eclipse	Oil Separator
71	828TY13Z2	Weston	Oil Temp. Indicator
40	119862	Weston	Carb. Air Temp. Indicator
400	AN5780-2	Weston	Wheel & Flap Position Indicator
1000	AN5780-2	G.E.	Wheel & Flap Position Indicator
40	828TY12Z2	Weston	Dual Carb. Temp. Gauge
11	727TY70Z2	Weston	Air Temp. Ind.
85	727TY72Z2	Weston	Air Temp. Gauge
88	727TY73Z2	Weston	Air Temp. Gauge
83	727TY74Z2	Weston	Air Temp. Gauge
10	728-40Z2	Weston	Air Temp. Gauge
21	8DJ29AAY	G.E.	Cowl Flap Ind.
22	77C5	Lewis	Carb. Air Temp.
16	76B19	Lewis	Cyl. Head Temp.
23	77C3	Lewis	Oil Temp. Gauge
13	77C4	Lewis	Oil Temp. Ind.
30	47B21	Lewis	Free Air Temp.
33	47B22	Lewis	Air Temp. Gauge
28	47B23	Lewis	Air Temp. Gauge
54	47B24	Lewis	Air Temp. Gauge
22	906-6-011	Kollsman	Diff. Press. Gauge
48	254BK-6-052	Kollsman	Diff. Press. Gauge
33	DW-47	Eclipse	Transformer
46	117-47	Edison	Fire Detecter Control Box
19	117-10	Edison	Control Box
345	981280	Kidde	CO2 Cylinders
43	966090	Kidde	Interconnector
104	966679	Kidde	Pressure Control
225	981591	Kidde	Tee
151	A-4614	Kidde	Switch
47	M870036B	Kidde	CO2 Cyl.
74	923748	Kidde	Oxygen Cyl.
326	982585	Kidde	Valve
325	AN60009-1B	Oh. Chem.	Valve
247	AN6009-2A	Oh. Chem.	Valve
47	2-1046-76	Parker	Valve (3000 PSI)
115	P4CA2A	Parker	Primer
68	SP4-2746-77	Parker	Restrictor Valve
105	SP4-2746-78	Parker	Restrictor Valve
68	6-746-10	Parker	Valve
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48	SP-2746-80	Parker	Restrictor Valve
60	SP4-2746-81	Parker	Restrictor Valve
127	PL2-2546-75	Parker	ConeCheckValve
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620	PL2-2546-77	Parker	ConeCheckValve
540	PL2-2546-78	Parker	ConeCheckValve
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250	AN4014	Erie Meter	Wobble (D-3) Pump
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70	AN3213-1	Scintilla	Ignition Switch
250	A-9 (94-3226)	Nesco	Ignition Switch
66	M862A	Jos. Pollack	Master Switch
148	PG208AS1	Honeywell	Switch Air Ram.
40	PG208AS7	Honeywell	Air Ram Switch
18	4582-AA-6C	Dynamic Air Eng.	Blower
24	U-709-15	Joy Mfg. Co.	Blower
20	V301B7	Aerotec	Pressure Relief Valve
419	450	Skinner	Filter
287	1033-4E1	White-Rodgers	Heater Control Switch
126	17322-2	Fenwall	Thermo-Switch
34	9804B	Vapor Car Heating Co.	Control Box
25	46B311	Vapor Car Heating Co.	Compensator
202	A812	Interstate Aircraft & Eng. Co.	Solenoid
46	146102	Bendix	Valve (0-500 PSI)
240	1265-900	Airex	Relief Valve
29	HC2109	Air Associates	Hyd. Cylinder
8	HC2110	Air Associates	Hyd. Cylinder
53	AN6203-3	Bendix	Accumulator 10"-1500 P.S.I.
90	JH950-R	Jack & Heinz	Starter Motor
140	K14949E	Marquette	Windshield Wiper Kit
188	EYLC-2334	Barber-Coleman	Control
230	921-B	Stewart-Warner	Heater (200000 BTU)
22	0655-D	Aro	Oxygen Regulator
65	ASDC2	CO2 Mfg. Co.	Fire Detector
97	6041-H-146A	Cutler Hammer	Relay (B-12)
237	6141-H69A	Cutler Hammer	Circuit Breaker
47	7264-404	Leach	Relay
22	M-2031	Air Associates	Actuator
11	FYLD9516	Barber Colman	Thermostat
51	AYLZ2284	Barber Colman	Micropositioner
20	72400	Hem. Stand.	Prop. Reversing Control
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46	A14-A-9708P	Westinghouse	Contactor
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718	B9A	Square D	Relay
6	83A94	Surface Combustion Co.	Heater
115	C6363-1-5A	Spencer	Circuit Breaker
115	C6363-1-2A	Spencer	Circuit Breaker
33	18784	Adel	Restrictor Valve
1700	AM1614-80	Heinemann	Circuit Breaker
31	BO8X-2	Allied	Relay
85	12924-2	Adel	Lock Valve
805	58G926	G.E.	Ballast Core & Coil
140	58G946	G.E.	Ballast
40	7210-24	Leach	Relay
66	25432	Airesearch	Flex. Cable
518	MT48C	Bendix Radio	Insulator
20	M-101-B	Aerotec	Pressure Switch
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52	715E	Fulton Syphon	Temp. Control
478	D9530	Adel	Selector Valve
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428	D9560-2	Adel	Selector Valve
179	D9632	Adel	Selector Valve
237	D9696	Adel	Selector Valve
744	D10044	Adel	Selector Valve
244	D10051	Adel	Selector Valve
814	74247 (TY, PH3)	Aero Supply	Valve
335	AN5830-1	Whittaker	Valve
74	AN5830-6	Whittaker	Valve
60	AN5831-1	Parker	Valve
65	1011-2	Eclipse	De-icer Valve
130	612-4A	Eclipse	Valve
2200	37D6210 (AN4078-1)	United	Solenoid Valve
1888	K1593-6D	Kohler	Valve
500	NF3-5	Mallory	Noise Filter
90	TA-19B	Bendix Radio	Transmitter
35	RA10-DB	Bendix Radio	Receiver
2585	AN3096-4	Grimes	Dome Light
775	AN3096-5	Grimes	Dome Light
1365	AN3096-6	Grimes	Dome Light
6	610-2C	Eclipse	Vacuum Pump
550	PD12K10	Stromberg	Carburetor
236	PR48-A1	Stromberg	Carburetor
90	1685-HAR	Holley	Carburetor
19	1375F	Holley	Carburetor
407	SF9-LN-2	Scintilla	Magneto
185000	LS4-AD1	Aero	Spark Plug
1	R1820-52	Wright	Engine
16	R1820-54	Wright	Engine
4	R1820-60	Wright	Engine
1	R1830-43	P & W	Engine
166	1045A	P & W	Bearing
500	3506	P & W	Flange
130	8288	P & W	Follower Ass'y.
814	35814	P & W	Blower Ass'y.
53	48362	P & W	Shaft
75	48363	P & W	Shaft
56	48392	P & W	Sump
390	48461	P & W	Gear
78	76236	P & W	Gear
1178	84289	P & W	Bearing
113	84487	P & W	Housing
77	84591C	P & W	Nose Housing
200	84350-D	P & W	Crankcase Ass'y.
200	84083	P & W	Cylinder
100	84084	P & W	Cylinder
200	84085	P & W	Cylinder
281	CR2791-G100-K4	G.E.	Relay
626	CR2792F101-A3	G.E.	Relay
41	G34464	Guardian	Relay
350	G31502-A	Guardian	Relay
22	146102	Vickers	Brake Valve
9	557-5	Eclipse	Check Valve
6	TFD-6500	Thompson	Pump
107	D12296	Adel	Pump
67	19100-2-101B	Kenyon	Check Valve
88	3135-11C	Eclipse	Pressure Switch
32	3V-217-HC	Pesco	Separator
100	27314	Purolator	Oil Filter
128	3801-3B	Eclipse	Fuel Quan. Gauge
33	420313	Wright Aero	Pump Ass'y.
46	416421	Wright Aero	Drive Ass'y.
76	U635A (AN4000-2B)	U.A.P.	Fuel Strainer
12	U8416-MM	U.A.P.	Oil Cooler Ass'y.
25	26675	Airesearch	Motor
35	AA14002A	Vickers	Accumulato
21	FD65-5	Diehl	Motor
81	3616	Bendix Radio	Control
23	3620	Bendix Radio	Station Box
17	C-8(B-2930-A)	Grimes	Cockpit Light
335	G1 (94-32376)	G.E.	Oxygen Pressure Signal Ass'y.
180	AW-CV-1-1	U. S. Gauge	Check Valve
740	1C-200	G.E.	Radio Noise Filter
15	1EAR-2808H	Pesco	Pump
7	SP-1-445-8	Parker	Selector Valve
8	1E621	Pesco	Pump
29	NEP-2	Eclipse	Auxiliary Power Unit
16	LER-30D	Lawrence	Auxiliary Power Unit
4	9CM46A2	G.E.	Generator
6	2P948EB	Pesco	Fuel Pump
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146	AW2-3/4-25K	U. S. Gauge	Manifold Press Gauge (Metric)
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18	SA/3A	Kidde	Impact Switch
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245	LMR-4	Micro	Switch
2094	FM-5	Spencer	Circuit Breaker
44	5BA25D-J4B	G.E.	Motor
31	5AM31JJ9A	G.E.	Amplidyne
111	5AM31NJ10	G.E.	Amplidyne
425	5BA40NJ1A	G.E.	Motor
189	5PD65-MB1	G.E.	Motor
25790	NR6L12	Torrington	Bearing
26	MS49A	Bendix Radio	Antenna Switch
45	D9060	C. P. Clare	Relay
298	727-TY37P	Weston	Air Temp. Ind.
2000	8909-K99	C. H.	Switch
2747	NAF310310-4B	Cannon	Plug
402	NAF310310-5B	Cannon	Plug
132	AN6209-8	Hydro Aire	Valve
50	AN6213-2	Bendix	Hyd. Valve
280	AN6220-4	Aeroquip	Coupling
27	AN6247-2	Adel	Hyd. Valve
14	UA8013-MM	United Aircraft Prod.	Oil Cooler
1175	RS-2	Mallory	Selector Box
172	A7012	Delco	Motor
6	8DJ13ABK	G.E.	Tachometer Indicator
200	2222-1F-2A	Eclipse	Tachometer Indicator
28	AN5770-2	Manning Maxwell Moore	Manifold Pressure Gauge
71	1003-4	Eclipse	Generator
427	NAF1016-1	Adams & Westlake	Light Ass'y.
616	NAF1016-2	Adams & Westlake	Light Ass'y.
1008	122BF	Leach	Relay
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CAB Splits on Airline Fare Investigation

- **Profits "unreasonable," some Board officials say.**
- **Others call high carrier return vital to growth.**

By Lee Moore

Major airlines are making an all-out effort to persuade Civil Aeronautics Board to drop the General Fares Investigation, slated for hearings May 1. The Board is presently split on the issue. Some CAB officials feel that continuing high airline profits may be "unreasonable," while others agree with the carriers that these profits are necessary. Airlines fear the investigation may lead to further fare cuts.

When profits slumped temporarily last spring, three of the present four Board members approved a $1 fare increase, but they did not agree on the question of raising fares even more by eliminating the 5% roundtrip discount. Since then, business has boomed and 1952 profits of the big airlines topped their record levels of 1951.

Nearly every airline filed a petition this month asking CAB to dismiss the fare investigation.

► **Sales Margin or Profit Return**—The airlines now urge a revolutionary approach to airline profits regulation by CAB. They recommend use of the sales profit margin instead of return-on-investment as proper yardstick for "reasonable" airline earnings.

Airlines' small capitalization in relation to annual sales is more like the motor carrier business (which Interstate Commerce Commission regulates mainly on a sales profit margin) than the heavily capitalized railroad and power utilities (which are regulated on an investment-return basis).

Judging by sales profit margins, their profits are not much out of line with other businesses now, the airlines point out. Present fares are about right. Airline profits are variable. A change now might upset the applecart, they contend. So CAB should drop the present expensive investigation, they believe.

Here are the main detailed arguments submitted by most domestic trunklines this month in petitioning the Board to drop the case.

► **Eastern**—The issue is whether fares shall go up or down, says Eastern Air Lines. The airlines want no change, according to EAL, and therefore the case is a waste of time and hundreds of thousands of dollars. There is no "issue," the carrier argues, and therefore should be no case. "The Administrative Procedures Act contemplates that hearings be held only in cases where there are 'issues' involving dispute," EAL says, and it is wasteful for the Board "simply to flex its investigative muscles."

Eastern proposes a new concept of CAB regulation by profit margin instead of investment return. Airline rate of capital turnover per year (sales divided by capitalization) is like that of the motor carriers, Eastern points out. Turnover ratio in 1949 was 144% for airlines, 160% for bus and 160% for trucking, compared with 37% for rails and 29% for electric utilities. Net profit margins of airlines and motor carriers are also similar. In the excellent airline year of 1951, Eastern says domestic trunk airline net profit margin was 6.3%, buses 5.6%, trucks 2.5% and electric utilities 17.4%.

► **American**—"The airline passenger is receiving the best bargain in transportation already," American Airlines states. In terms of 1939 dollars, cost of the average ticket is less than 3 cents per mile, and quality is much improved. In 1939 a New York-Chicago first-class ticket cost $45 and took 4 hr., 35 min. Now an aircoach ticket costs $33, the trip takes 3 hr., 15 min., and the service is far better than first-class service of six years ago.

"There should be no reduction in a fare level which has not produced sufficient earnings to attract equity capital," American argues. Conversion to jet transports will start between 1955 and 1958, AA predicts. The jets will cost $4 million each, plus $1.2 million to $2.0 million each for spare parts. If the jet fleet numbers 30 to 40% of the four-engine piston-engine fleets now on hand or on order, the cost will be $756 to $873 million. Adding the $279-million value of present undelivered orders for conventional planes, American predicts capital requirements of more than $1 billion.

American notes possible sources of that capital. Depreciation reserves are totally inadequate, the carrier contends, because costs rise rapidly. A DC-3 in 1949 cost $125,000; DC-6 in 1945, $720,000; DC-6B in 1951, $1.2 million; and a DC-7 in 1953, $2.1 million.

Depreciation reserves available to buy the predicted $1-billion fleet will come to only about $250 million, American estimates. The remaining $800-$900 million must come from future earnings and new financing. In 1958, if 60% of earnings at the 1951 rate can be accumulated, the airline still will need $650 million of outside financing.

But airline securities do not attract much equity capital, American says. Offering prices of all the airline issues in the seven years 1946-52 total $157 million. Current market values of nearly 90% of these issues are lower than their original offering prices.

Thus almost every airline security issue still is below its original offering price, despite both general price inflation and the rise of the stock market. The airline securities market still is weak, American says. From the end of

Airline Net Profit Margins

(Compared with other government-regulated industries)

	Airline	Bus	Truck	Rail	Electric Power
1946	loss	13%	3%	14%	22%
1947	loss	9	3	18	19
1948	0	8	5	18	17
1949	5	6	4	23	19
1950	7	5	4	19	19
1951	6	6	3	*	17

* Not available.

Note: Included are domestic trunk airlines, Class 1 motor carriers of passengers, Class 1 motor carriers of property, Class 1 line haul railroads, and Class A and B electric utilities.

Source: Eastern Air Lines petition to dismiss CAB docket No. 5509.

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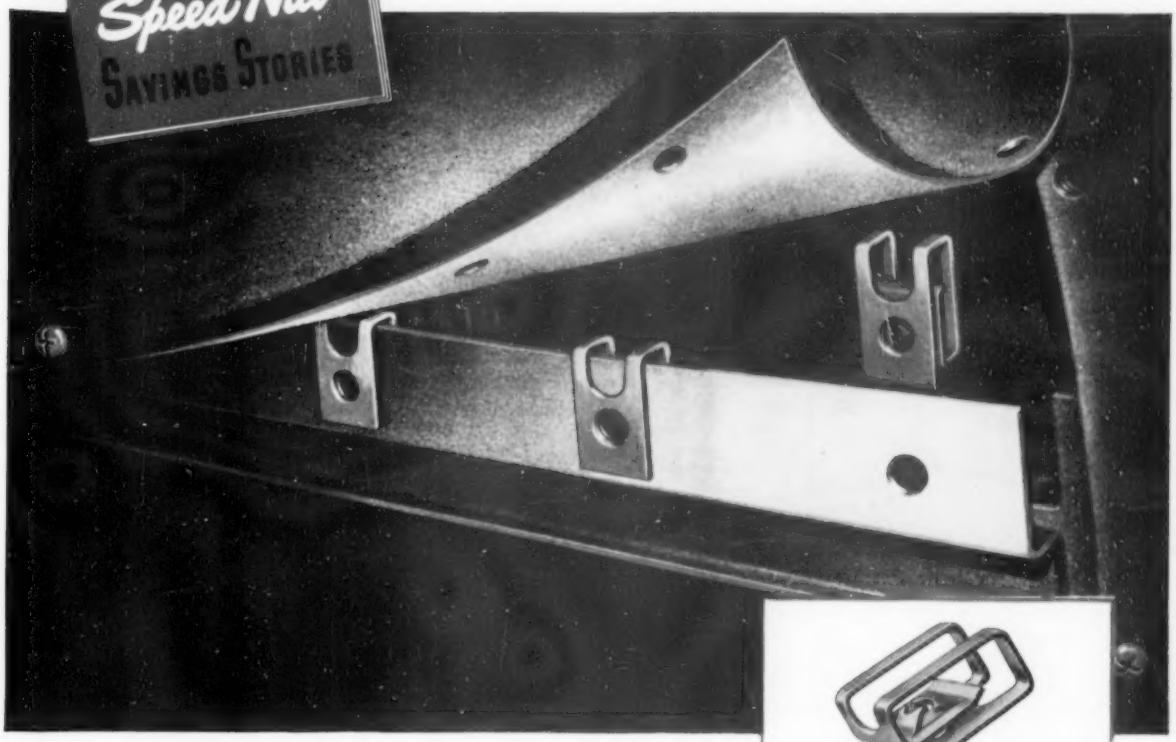

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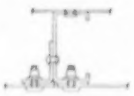

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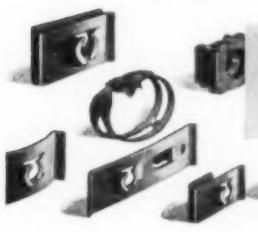

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1951 to Sept. 26, 1952, airline securities dropped 19%; electric and gas utilities gained 9%; manufacturing companies stayed even, and the composite gained 1%.

American cites two reasons for the poor market:

• **Fluctuation.** Domestic trunklines showed a profit during four years of the 1946-52 period; net losses were recorded the other three years.

• **Low dividends.** In 1946-51, airline dividends totaled only 2% of the stockholders' equity—a lower yield than a bond.

Therefore, airlines may be forced by low earnings to borrow instead of floating new stock issues. In the Big Four mail rate case, CAB said airline debt should be less than 40% of total invested capital; yet, American says, the average airline capitalization in 1947 was 47% debt.

Reasonable profit margins must be permitted by CAB to bolster airline earnings and security values to continue industry expansion, American concludes.

▶ **TWA**—"There are no established trends in costs, revenues or profits of TWA, or in the national economy, that would make possible a statesmanlike decision in this proceeding at this time," Trans World Airlines argues. Even the $1 fare increase did not offset its cost rise this year, the carrier says. Operating cost in 1952 went up 18%, while revenues gained 16%. There was a slight increase in net operating income before taxes, but TWA's net operating income per revenue ton-mile decreased almost 15%.

TWA also notes the aircoach business is new and volatile. Fares are fluctuating. Nonsked fares, "a vital force in fixing the fares of the domestic trunklines, are not even at issue in this case," the airline says.

Because coach is the most vital factor in the present airline business outlook, TWA asks how CAB can look at first-class fares alone. Coach service expansion is rapid, and equipment programming is in a state of flux. Until these situations settle, CAB should not try to establish a new relationship of first-class fares to coach fares, TWA concludes.

▶ **Northeast**—Northeast Airlines is against a fare increase, as well as any decrease. "In the shorthaul market, where the revenue need is greatest, increased fares cannot be expected to create increased air carrier revenues," NEA says. "In fact, in Northeast's case, any increase . . . would place Northeast at such serious competitive disadvantage in relation to other (surface) media of transportation . . . as to assure a decline in revenues."

The carrier also emphasizes that sales profit margin is more applicable than investment return for airline regulation.

Postwar Returns On Investment*

	Average 1946-51	1951
Air transport	5%	16%
Manufacturing	16	14
Power utilities	9	9
Telephone & Telegraph	8	9
Class I rails	4	5

* Net earnings after taxes reported as percent of net assets (total assets less liabilities) at beginning of each year.

Source: Delta Air Lines petition to dismiss CAB Docket 5509.

▶ **Delta**—"Since the Board instituted this proceeding (fares investigation) on Apr. 9, 1952, a new policy of conservatism toward subsidy, including trunk airline subsidy, has been accentuated in government thinking," Delta Air Lines notes.

The company also says the government concept of "reasonable profit" for a subsidy-guaranteed industry must change radically when that industry goes off subsidy and relies on its own earnings and savings to carry it through bad times, or rapid capital expansion.

▶ **Capital**—Capital Airlines says the CAB cut of aircoach fares in off-peak hours already has dropped fares substantially. And expansion of all coach services is diverting more passengers to the lower-fare coach services, further dropping average fares, the airline contends.

Capital's net operating income in 1952 was $2 million, compared with $3.7 million in 1951.

Higher shorthaul fares are what Capital needs most, the company says, because of the shorthaul character of its routes, which average 312 miles. The $1 fare increase a year ago helped, but didn't go far enough, Capital says. However, since this case gives "no reasonable assurance" of a more equitable result, Capital urges that the case be dropped.

▶ **Braniff**—Braniff Airways emphasizes that the CAB investigation of fare levels as a function of profits will be weighted heavily by larger profit returns of the Big Four—American, Eastern, TWA and United Air Lines. A fare low enough to bring "reasonable" profits to the Big Four might ruin the smaller airlines, Braniff says.

Braniff points out that a drop in a transcontinental fare also must cut fares on the shorter direct and indirect route segments, because the regional airline must quote competitive fares along such routes.

The carrier says the CAB investigation of fares already has hurt the market appraisal of airline securities.

▶ **Chicago & Southern**—"For a subsidized carrier, the proceeding is pointless," Chicago & Southern Air Lines says. Subsidy carriers already charge less than cost of hauling the passenger, and their chief aim is to increase revenue and get off subsidy. To do this, the airlines must charge the cost of the service. Thus, unless a fare cut led to "spectacular" revenue gains, the present investigation would have no point for subsidized carriers. Spectacular gains in first-class revenue are not expected to result from any proposed cut, C&S says.

The company also says "increasing costs and declining profits in 1952 indicate the strong probability that the so-called '53-cent' class of carriers (just off subsidy) may require renewed subsidy assistance in the not-too-distant future, and one of these carriers, Braniff, already has pending an application for reinstatement of a 'need' rate as a result of its Mid-Continent merger."

C&S concludes that CAB should not proceed with this investigation, at least until it has decided whether the sales profit margin or the investment return is the proper approach to judging "reasonable profits."

UAL Earns Record $10.5-Million Profit

United Air Lines earned a record profit of $10.5 million in 1952, cut its unit costs and started several engineering and research projects to reduce long-term costs further, the carrier's annual report reveals.

Highlights of the report:

• Costs dropped 6% to 26 cents per available ton-mile, compared to 28 cents the year before. This shows an absolute gain of operating efficiency, as well as other miscellaneous unit cost savings.

• Cost per revenue ton-mile stayed the same as 1951, at 44 cents. It shows the company's overall profitability per unit of expense ran equal to 1951.

• Expansion plans were announced for low-fare coach service to Boston, Cleveland, Detroit and Washington and transcontinental from Los Angeles.

• DC-6 fleet conversion to Pratt & Whitney Aircraft R2800 CB-16 engines and Hamilton Standard high-activity (43-E-60) propellers was started, simplifying maintenance and operations by standardizing the DC-6 engines and props with those of the newer DC-6B and Convair 340. The standardization program will cut costs further by reducing inventory of spare parts required. Engine and prop conversion is more than half completed.

• Airborne radar research and similar

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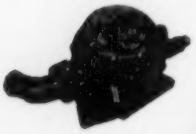

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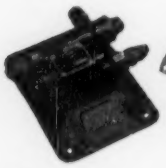

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projects were begun in an effort to maintain "100% all-weather year-'round operations" within a decade.

- Total revenues gained 24% to $159 million.
- Passenger load factor dropped from 75% to 73% of capacity. But this is a small drop to a 33% increase in total capacity.
- Total undepreciated value of UAL's operating equipment and property jumped $33 million, increasing from $106 million at the beginning of 1952 to $139 million Dec. 31. Net book value of property and equipment gained $24 million to $82 million.
- Working capital gained $14 million, increasing from $6 million to $20 million. Long-term debt increased only $5 million. Biggest sources of net addition to cash during the year were earnings, $10.5 million, and sale of convertible preferred stock, $18 million net. Depreciation, amortization, etc., totaling $20 million paid for nearly half of the $42 million invested in operating property and equipment during the year. United has spent $165 million on capital equipment in the postwar period.
- Total taxes of $34 million paid in 1952 were more than three times the $10 million (non-subsidy) mail pay paid by the Post Office to United.
- Dividends on common stock were established for the first time on a 25-cent quarterly basis, plus a year-end extra of 50 cents. Total common and preferred dividends of $3,664,982 came to one-third of total earnings.
- Stockholders' return on their investment came to about 18%, slightly more than the 16% a year ago. But net profit margin on sales was less than 7%.

► **Question Marks**—Among the major uncertainties cited by the company:

- **New routes.** UAL has completed hearings before the Civil Aeronautics Board, seeking removal of Chicago-Northwest route restrictions to compete directly with Northwest Airlines' nonstop service. United, American Airlines and Trans World Airlines are asking CAB permission to compete with each other on remaining one-line and two-line prize routes opened up in three new area route cases: Chicago-New York, Chicago-West Coast (Denver case), and New York-Southwest-West Coast (Oklahoma case). UAL does not comment as to whether gains to be made on its own route extensions would be offset by increased competition from carriers that may make similar inroads on United's present system.
- **General fares investigation.** United, along with all the other trunklines, expresses fear of possible fare cuts that may arise from CAB's General Fares Investigation.
- **Taxes.** United points out that its average ticket sale was $47.78. Of that revenue, $10.67 went to direct taxes ($6.23 transportation tax, $3.27 income tax and 1.17 other), $34.22 went for cost of providing the service (including more hidden taxes), and $2.98 was left for net profit on the total $47.78 for the ticket.

New ACC Chairman Is Commerce Official

The White House has named Commerce Undersecretary for Transportation Robert B. Murray, Jr., as new chairman of the Air Coordinating Committee—the executive agency for civil-military air policy. White House liaison man on ACC is Charles F. Willis, assistant to Sherman Adams, top White House aide.

Willis sat in on the recent first ACC meeting under the new Administration. At the next meeting, scheduled for the third week in April, members will face a tough agenda (AVIATION WEEK Feb. 23, p. 68).

Murray succeeds CAB chairman Oswald Ryan as committee chairman. Ryan retains his regular status as ACC member representing CAB.

President Eisenhower has not yet designated the Air Force member of ACC. Two possible Air Force designees are: Undersecretary James Douglas, a former American Airlines director, and Assistant Secretary Roger Lewis, former Curtiss-Wright Corp. sales manager. Meanwhile, Air Force alternate member is USAF Deputy of Civil Aviation Milton M. Turner.

Other ACC members are: Earl D. Johnson, Army Undersecretary; John F. Floberg, Navy Assistant Secretary for Air; J. Paul Barringer, State Department Director of Transport and Communications Policy; H. Chapman Rose, Treasury Assistant Secretary; John C. Allen, Postmaster General; J. Weldon Jones, Budget Bureau economic advisor (nonvoting); and Col. Alvin B. Barber, National Security Resources Board (nonvoting).

IATA Copter Meet

(McGraw-Hill World News)

San Juan, P. R.—Top ranking U.S. and foreign rotary-wing aircraft designers, manufacturers and operators are scheduled to attend a two-week session in San Juan, which will stress use of helicopters in passenger transport. The meeting, under the auspices of the International Air Transport Assn., will be held Apr. 20-May 2 at the Caribe-Hilton Hotel.

Some 200 IATA members represent-

ing all phases of the industry, including maintenance, engineering, operations, communication and meteorology are expected to attend. Air terminal congestion, air navigation problems and future traffic operations will also be on the agenda.

Pioneer Subsidy

- **CAB turns down higher mail rate for Martins.**
- **Ruling hits local service 2-0-2s and Convairs**

Civil Aeronautics Board set back Pioneer Air Lines' management and investors last week with a unanimous decision denying extra subsidy for the carrier's recent switch from DC-3s to larger, more expensive Martin 2-0-2s.

The Board set an effective mail rate of 25.40 cents a plane-mile, which will produce $1,000,500 a year. This is enough to support DC-3 service on Pioneer's route, but is not sufficient for operation of the heavier Martins, or Convairs. The rate is effective as of Apr. 2, 1952, the date Pioneer asked for the increase.

Pioneer announced it immediately would suspend some services, and might temporarily suspend all service during transition back to DC-3s.

► **Prior Warning**—The uncompromising finality of the CAB decision surprised some segments of the industry. But the Board opinion reveals that former CAB chairman Donald Nyrop warned Pioneer president Robert Smith last May 7: "It is the current view of the Board that the increase should not be underwritten with mail pay, but being undertaken as a risk of management, is to be borne by the carrier without recourse to additional mail pay subsidy."

This statement was not made public by Pioneer or the Board, but a similar view was presented publicly by counsel of the CAB Bureau of Air Operations during the winter.

Here is what the CAB decision will mean, according to informed observers:

• **Pioneer must sell** its nine Martins and buy DC-3s.

• **DC-3 replacements** must not be Martins or Convairs of the present series, CAB believes, because local service is an extremely shorthaul, small-field operation.

• **Local lines must stay local**—not expand into the trunkline field.

• **Braniff and Continental** are saved from the threat of Pioneer competition. Other trunks similarly are relieved from worry about local service airline expansion.

• **CAB subsidy policy** does not change

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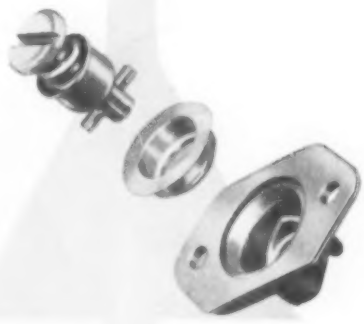

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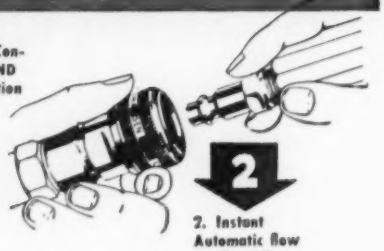

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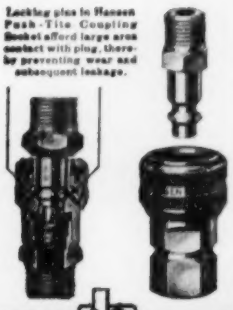

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significantly with this decision. There is a trend toward tightening up on subsidy grants, but CAB bases the Pioneer decision solely on the question of management widsom in buying Martin 2-0-2s for operation over Route No. 64, "we would not be advancing one step further towards a better and more economic aircraft for local air service."

▶ **Convairs, Too**—The Board also implies plainly that it will not underwrite Convairs for local service airlines: "The Martin 2-0-2 was not designed to meet the economic or operational problems of a local air service system, but was tailored to trunkline requirements. . . . Convair aircraft, which are larger, faster, and more expensive than the Martin 2-0-2 . . . like the Martin, were designed with trunkline requirements primarily in mind."

The Board says a mixed fleet of 2-0-2s and DC-3s would be even more costly than the present Martin operation. Thus the Board leaves but one avenue open for Pioneer: sell the Martins and again buy DC-3s. The new 25.40-cent-a-mile rate compared with previous rate of 26.89 cents.

A recent unaudited Pioneer income statement reports a net operating loss of $390,000 for 1952 at the old mail rate.

CAB estimates the new $1,000,500 annual rate is $903,000 subsidy and $97,500 compensatory for mail carriage.

▶ **Financial Impact**—Pioneer officials did not disclose their next move. President Smith was in Washington when the Board announced its decision. He flew back to Dallas the following day to discuss what should be done next.

The Board does not believe Pioneer will suffer much financially, if the present situation on the second-hand plane market continues. It has been asserted, CAB says, that Pioneer sold its DC-3s at the peak of the market last year, and can buy DC-3s back cheaper today. CAB says it is also "asserted" that "current market value of Pioneer's Martin 2-0-2s substantially exceeds the price paid by the carrier" ($300,000 each plus spares and overhaul cost).

▶ **Local Service Only**—The Board opinion states: "It is our conclusion that management's forecasts and estimates were unreasonable and that a sound evaluation of the relative profit and loss potential to the carrier of the DC-3 and its replacement with the equipment considered and chosen by the carrier should have led to the retention of the DC-3s.

"The economics of Martin 2-0-2 operation . . . will necessarily have the effect of turning Pioneer's previously successful efforts at developing local air transportation for the cities currently served on its route, and expansion of such service to cities in its area not yet served, to expansion into, and competi-

tion with, trunkline operations," the Board states. "We believe that the latter road invites a continued and unwarranted drain on the public treasury and danger to the entire local service experiment."

"We note that one of the considerations moving Pioneer's management to re-equipment with postwar trunkline aircraft was its desire to maintain equipment parity for competitive reasons with trunkline carriers. . . ." The Board concludes this point with the statement, "Pioneer's authority to provide service over Route No. 64 was not granted for the primary purpose of competing with trunk carriers, and we do not recognize competitive considerations as a significant justification for (subsidizing) new equipment."

▶ **Pioneer Reaction**—A Pioneer spokesman termed the CAB decision "A worm's-eye view of the future of local transport." He said this is the first time the Board ever has refused to underwrite cost of introducing new planes, citing Northwest's $10-million total increase in mail pay 1948-50 over 1947, before introduction of Stratocruisers. He says such locals as Central doubled or tripled their subsidy need when they went from small planes like the Beech Bonanza to the DC-3.

Pioneer also notes that it is the oldest local service line, having started in 1945 with nine-seat Lockheed Electra transports. Pioneer was one of the lowest-cost operators before the switch from DC-3s to 2-0-2s.

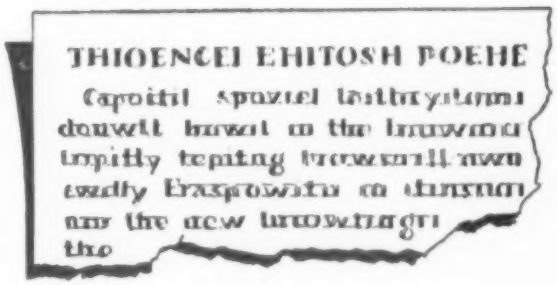
CAB disagrees with the Pioneer argument that new equipment always rates subsidy support. In previous cases, the Board opinion states, the setup in equipment has held promise of increasing efficiency. But the Martins are not suited to local operations. Pioneer counters that the DC-3 will never get the locals off subsidy—the vehicle "with a larger container" (capacity) is the answer, and the Martin was the best bargain available.

Sabena Copters Haul 106.7 Tons of Mail

Sabena Belgian Airlines' helicopter postal service carried 106.7 tons of mail —approximately 21 million letters—between Brussels and eight other Belgian cities during the first two full years of operation, the carrier reports.

Flying three Bell 47-D1 copters, the airline maintained an overall regularity of 97.3% over the daily 268-mi. pickup route last year, compared to 91.2% during the first year of service.

A Sabena spokesman says time spent on the ground over the entire route has been cut to between 29 and 42 min. The cost of the operation is 63 cents per mile.



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More Reliability Needed—Part 2

Since introduction of the de Havilland Comet to scheduled service, many Americans have been bemoaning the tremendous jump the British have gotten on us. This bemoaning is valid; our friends across the sea are ahead of us in many respects. This jet transport is merely another illustration of how the British often get ahead of us because of foresight, their ability to grasp and quickly make use of new ideas and the guts to look at a problem objectively.

Now that we have been shown the way, we too can build a jet transport. But this is the crux of the matter—so often we have to be shown the way. It is easy to view our thousands of shiny airplanes, our tremendous production facilities and impressive statistics and be smug about our superiority. This, however, is a superiority in numbers, in sheer weight of output and has nothing whatsoever to do with superiority of ideas and thought.

► **Centerline Approach Lighting**—The operational end of air transportation is another field which shows our backward tendencies. For many years a small band of pilots fought for a decent approach light system. Only within the last few months has this dream been realized—still on paper, of course. But the British saw the value of centerline lights years ago, standardized on them. And our system is a refinement of theirs.

Last time out this column discussed the fallacies of the U. S. weather minimum theories. Now this may be monotonous but we must repeat, Great Britain is ahead here also. They have accepted the fact that visibility along the landing runway is the controlling item for landings in bad weather, and that minimum altitude is a function of type of aircraft, its instrumentation, the terrain, landing aids, etc., and not a dependency on a mythical cloud height.

► **How It Works**—Their system works like this: Airplanes can descend, regardless of forward visibility, to whatever height above the ground that the airline has proved is safe for its particular planes and equipment. At each airport an observer measures the visibility from the end of the landing runway—in the direction which the plane will land, of course—and this information determines if a landing attempt is feasible. In other words, the one bit of data most useful to the pilot, "How far can I see?," is available. Obviously, this is a substantial thing on which to base a landing.

Opposed to this system, we use visibilities measured from a weather station sometimes removed by more than a mile from the point of touchdown. If landings are being made with ½ mile visibility, this means the observer cannot see the landing area. An operation, taking place say in Boston, therefore might just as well use a report of the visibility in Chicago. Since neither observer can see the place where the landing is to be made, both reports have about equal value.

► **Dutch Use System**—This idea of a "critical altitude"—an altitude based on the realities of type of airplane, equipment and runway visibility, without the legal folderol—is good. With it the British are flying lots more weather than we are. The Dutch, too, according to my information, are landing with as little as 500 yards visibility.

At present the U. S. has only one airport making runway observations. This is an experimental project at Washington National, but of course "ceilings" and all the other legal hocus-pocus are still there.

A look at these new theories of weather flying would be a worthwhile step toward attaining the reliability we need. The fear expressed by many, however, is that, like the approach lights, a change in present theories will require many years of battle against backward bureaucratic thinking. Will it?

AVIATION CALENDAR

Mar. 23-25—Third Midwestern Conference on Fluid Mechanics, University of Minnesota, Minneapolis.

Mar. 23-26—Institute of Radio Engineers National Convention, Waldorf-Astoria and Grand Central Palace, New York, N. Y.

Mar. 23-27—Eighth Western Metal Exposition and Congress, Pan-Pacific Auditorium, Los Angeles.

Mar. 23-28—Congress of Civil Aviation Conference, a joint meeting of trade organizations; Theme: 50 years of aviation progress. Airport Operators Council and American Assn. of Airport Executives are holding annual meetings simultaneously, Kansas City, Mo.

Mar. 25-27—National Production Forum of the SAE, Hotel Statler, Cleveland, O.

Mar. 31-Apr. 2—First International Magnesium Exposition, National Guard Armory, Washington, D. C.

Mar. 31-Apr. 2—Safety meeting Air Line Pilots Assn., Sherry Hotel, Chicago.

Apr. 15-16—First annual engineering management conference, Management Division of The American Society of Mechanical Engineers, Rackham Bldg., Detroit.

Apr. 20-23—Aeronautic Production Forum, National Aeronautic Meeting and Aircraft Engineering display (SAE), Hotel Governor Clinton and Hotel Statler, New York.

Apr. 20-May 2—Annual Conference of Technical Committee, International Air Transport Assn., Caribe Hilton Hotel, San Juan, Puerto Rico. Helicopter Symposium will be a principal feature.

Apr. 21-24—SAE Committee A-6, Aircraft Hydraulic and Pneumatic Equipment meeting, Governor Clinton Hotel, New York, N. Y.

Apr. 25-May 2—First annual National Transcontinental Handicap Air Cruise for private planes of 300 hp. or less, Philadelphia to Palm Springs, Calif., sponsored by Philadelphia Junior Chamber of Commerce.

Apr. 29-May 1—1953 Electronics Components Symposium (AIEE-IRE), Shakespeare Club, Pasadena, Calif.

May 6-7—Second annual Skylady Derby, sponsored by Women's National Aeronautical Assn., sanctioned by NAA and conducted under FAI rules. From Fort Smith, Ark., to Memphis, St. Louis, Kansas City and return to Fort Smith. WNAA's twenty-fourth annual convention will follow at Fort Smith.

May 11-13—National Conference on Airborne Electronics, Dayton Biltmore Hotel, Dayton, O.

May 16—Armed Forces Day, open house programs at local USAF, Navy, Army, Marine and Coast Guard installations.

May 18-22—Fifth National Materials Handling Exposition, Convention Hall, Philadelphia.

July 27-Aug. 2—1953 Model Airplane Championships, U. S. Naval Air Station, Willow Grove, Pa.

Sept. 7-13—1953 SBAC Coronation Year Flying Display, Farnborough, Hampshire, England.

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KAISER METAL PRODUCTS, Inc.

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EDITORIAL

The Awakening to Safety

Laurance S. Rockefeller's recent $25,000 contribution to the Flight Safety Foundation is an important milestone in aviation development. It is recognition from one of America's outstanding men of the importance of safety to aviation. It is also a vote of confidence in a young, forward-looking, non-profit organization that a few years ago was only a gleam in the eye of its founder, Jerome Lederer.

The foundation is dedicated to advancing safety in all branches of commercial and private flying.

Laurance Rockefeller

Jerome Lederer

Mr. Rockefeller, in making the contribution, said "I feel that the work of the Flight Safety Foundation, which has proven in the past five years so important to the advancement of aviation safety, should have broad support from the many groups and individuals who are interested in aviation. The promise of substantial contributions which the foundation has already received indicates to me that its objective of an expanded program can and will be achieved."

This added income, the largest contribution to date, will enable the foundation to increase its personnel modestly—from its early one-man setup.

Mr. Lederer, in recent comments on William Littlewood's annual Wright Memorial lecture, sponsored by the Institute of the Aeronautical Sciences, highlighted the type of realistic thinking the aviation industry is beginning to devote to safety.

"The safe way of doing a job is usually, in the long run, also an economic and efficient way to do it," he said. "Safety is not solely a way to save lives and to prevent suffering. It is also a way to stimulate creation of new wealth and to conserve the wealth we already have.

"No one to my knowledge has developed a yardstick for measuring safety that is acceptable to varying interests. Everyone is for safety just as everyone is against sin and for virtue. But expediency and temptation often weaken our will to be virtuous. Strangely enough, the word 'safety,' except in its absolute sense of freedom from danger, means different things to different people.

"To the airline passenger it means absence of anxiety.

"To manufacturers, safety may interfere with the production line or reduced range and payload.

"To the airline vice president in charge of public relations, safety is a word that should seldom be mentioned above a whisper.

"To the newspaper editor, aviation safety is something to be hidden on the last page, along with railroad accidents.

"To all of us in aviation, safety should mean the public acceptance and support of air transportation.

"Mr. Littlewood indicates in strong terms what safety should mean to the engineer.

"He says it is the prime duty of the engineer to simplify the tasks of the crew so that more can be accomplished with improved safety and efficiency. He criticizes engineers for their tendency to minimize reserve fuel requirements and other essential factors which cut into range or payload, and he calls attention to the engineer's negative response to safety suggestions. . . .

"He stresses repeatedly the need to design so that failure of a component will not create additional or cumulative hazards, and he does all this as a challenge to the quality and capacity of air transport design engineering.

"These are serious reflections on the design engineer and his interest in safety. I agree with Mr. Littlewood, but the engineer is probably less to be blamed than our educational system and, until recently, the managers of industry, the implications and importance of safety, of always designing with the user in mind, has seldom been fully explained and properly interpreted to the engineer. Emphasis has been on performance.

"A well-known professor of aeronautics has declared that safety, per se, is a relatively new concept in engineering curricula, not too seriously considered, if ever, by many instructors. If the industry wants safety consciousness or safety attitudes inculcated into the engineer, industry which hires the product must put the pressure on the colleges, this professor says.

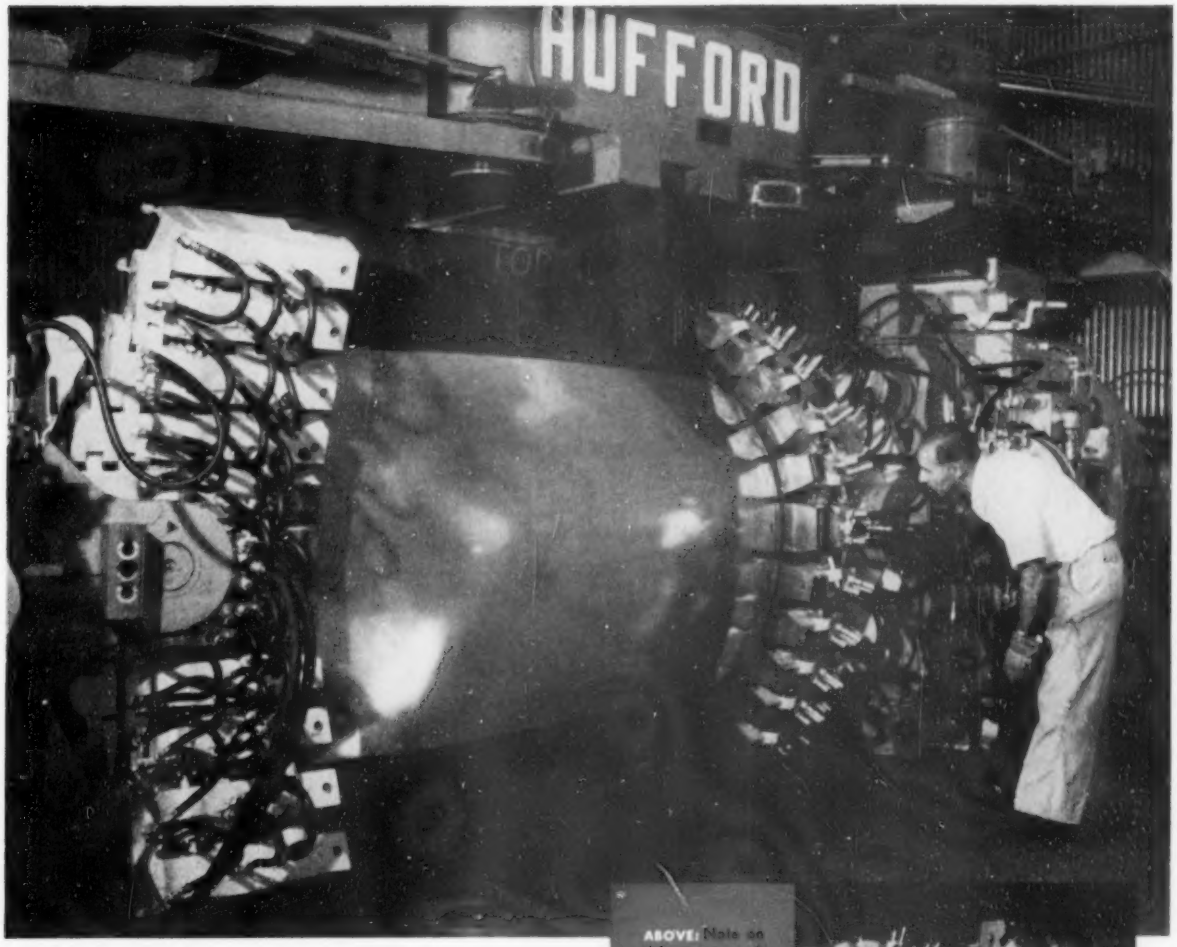
"The industry has not demanded safety and reliability with the same persistence that it has demanded performance.

"There is a strong trend toward independent safety specialists reporting to high authority.

"These safety specialists, if they report to top management, act as a rallying point for safety-conscious employes who are not often in a position to bring their criticisms or ideas to the attention of top management. And they are becoming especially valuable to industry by educating engineers on the constant need to think of the design in terms of the other man—the pilot, the mechanic and the passenger."

Aviation's entire future is built on the safe airplane. The stakes, once insignificant, have grown faster than many of us can comprehend. Our aircraft industry at this moment has a backlog of $17.6 billion. Our U. S. flag domestic and international airlines took in $1 billion in operating revenues in 1952. Our investment in safety, so far woefully inadequate, is showing slow but sure signs of a rising curve.

—Robert H. Wood



New Hydra-Curve Jaws

ON MODEL 46 HUFFORD

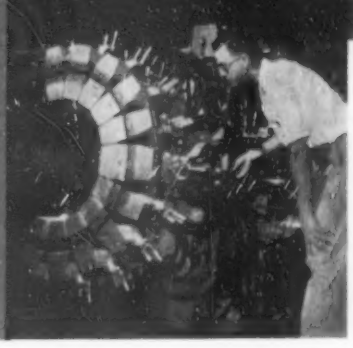
make estimated savings of

$23,797.40

on 200 planes*

ABOVE: Note on this part each jaw is curved oppositely; left jaw concave, right convex. Curves can be widely varied to include even "S" shapes.

RIGHT: Articulated jaw segments show extreme curvature possible



By estimating cost of making 30 various parts for 200 planes on different types of forming machines, the Hufford Model 46 equipped with the new Hydra-Curve Jaws showed a material saving alone of $20,180.00! In addition, $3617.40 in labor savings would be effected.

These figures are indicative of the money-saving advantages possible with the new Hufford Hydra-Curve Jaws on Hufford Stretch-Wrap Forming Machines.

BUT MATERIAL SAVINGS ARE NOT ALL... The Hydra-Curve Jaws lower transitional area stresses between die and jaw, reducing sheet breakage losses; overcome wrinkling and insure better skin fits, which cut assembly time. With these new curvable jaws, many jobs are being successfully formed in the "T" condition, saving furnace hours.

DIE COSTS ARE LOWERED TOO because expensive-to-make dish-outs are no longer required to relieve stresses.

If you want new cost reductions, if you want stretch-wrap forming at its best, rely upon Hufford... **FIRST IN THE FIELD, FIRST IN SALES, FIRST IN SAVINGS!**

**All figures from the files of a leading aircraft manufacturer. Name on request.*

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Machine Works Inc.

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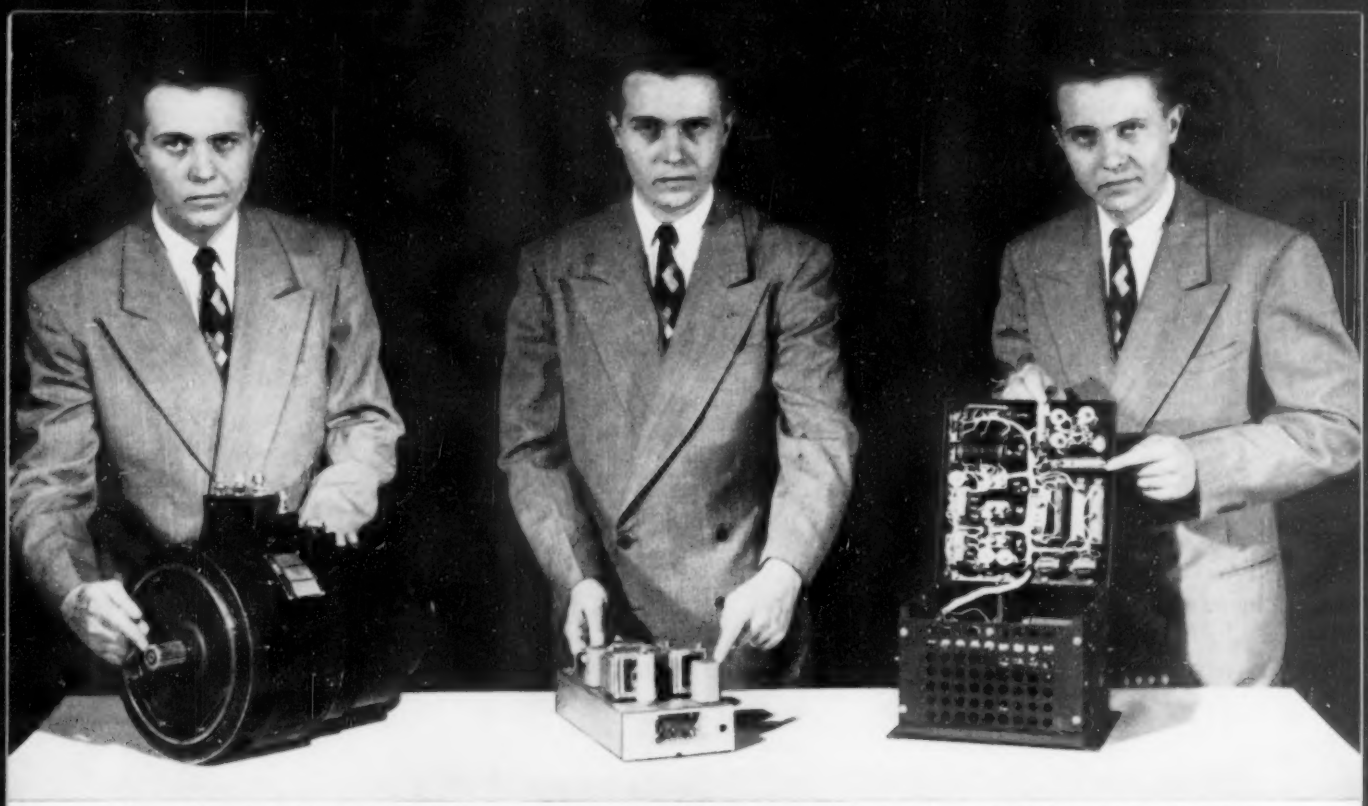

ENOUGH ELECTRICITY FOR FIVE CITY BLOCKS can be produced by a G-E 30 kva alternator (left, above). Teamed with the static voltage regulator, right, G-E alternators can be paralleled without exciter reversal problems. Compact, easy-to-service control panel (center) gives 5-way protection.

Name your aircraft...G-E generator systems can be used with any drive in any application

Direct-drive, hydraulic drive, or accessory turbine drive—a G-E designed a-c generator system can be used with all three.

The "power-package" shown at the top of this page can be teamed with a G-E accessory turbine drive to simplify high-density aircraft design, improve aircraft performance. It can be used with hydraulic drives if specifications do not allow remote ducting. For variable frequency or non-parallel applications, the alternator can be geared directly to the engine. For flexibility, consider:

- G-E alternators are now available in ratings from 15 to 90 kva, for either 40°C or 80°C ambients.
- G-E static voltage regulators can be installed anywhere, come in either narrow- or wide-speed models that handle all alternator ratings.
- G-E control panels incorporate five built-in system-protection features*—all in easy-to-service panel units.

Nine leading U. S. military aircraft today fly with reliable G-E a-c power. For more information on the benefits *you* can gain for your aircraft with a G-E system, write for Bulletin GEA-5905 ("AC Generator Systems for Aircraft"). The booklet is amply illustrated, gives complete equipment and sales features. Write *Section 210-75, General Electric Company, Schenectady 5, N. Y.*

*Protection against differential faults, underfrequency, open phase, and exciter failures; also overvoltages in both parallel and isolated systems.

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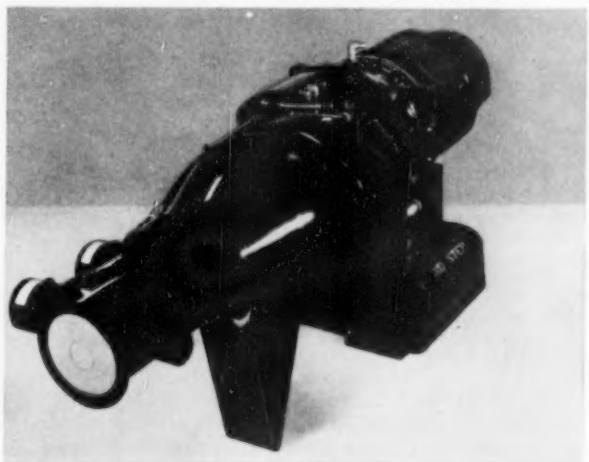
GENERAL ELECTRIC



G-E air turbine drives can be developed to your requirements. Above unit maintains close speed control, is suited for parallel operation. For more information, contact your nearest G-E Apparatus Sales Office.